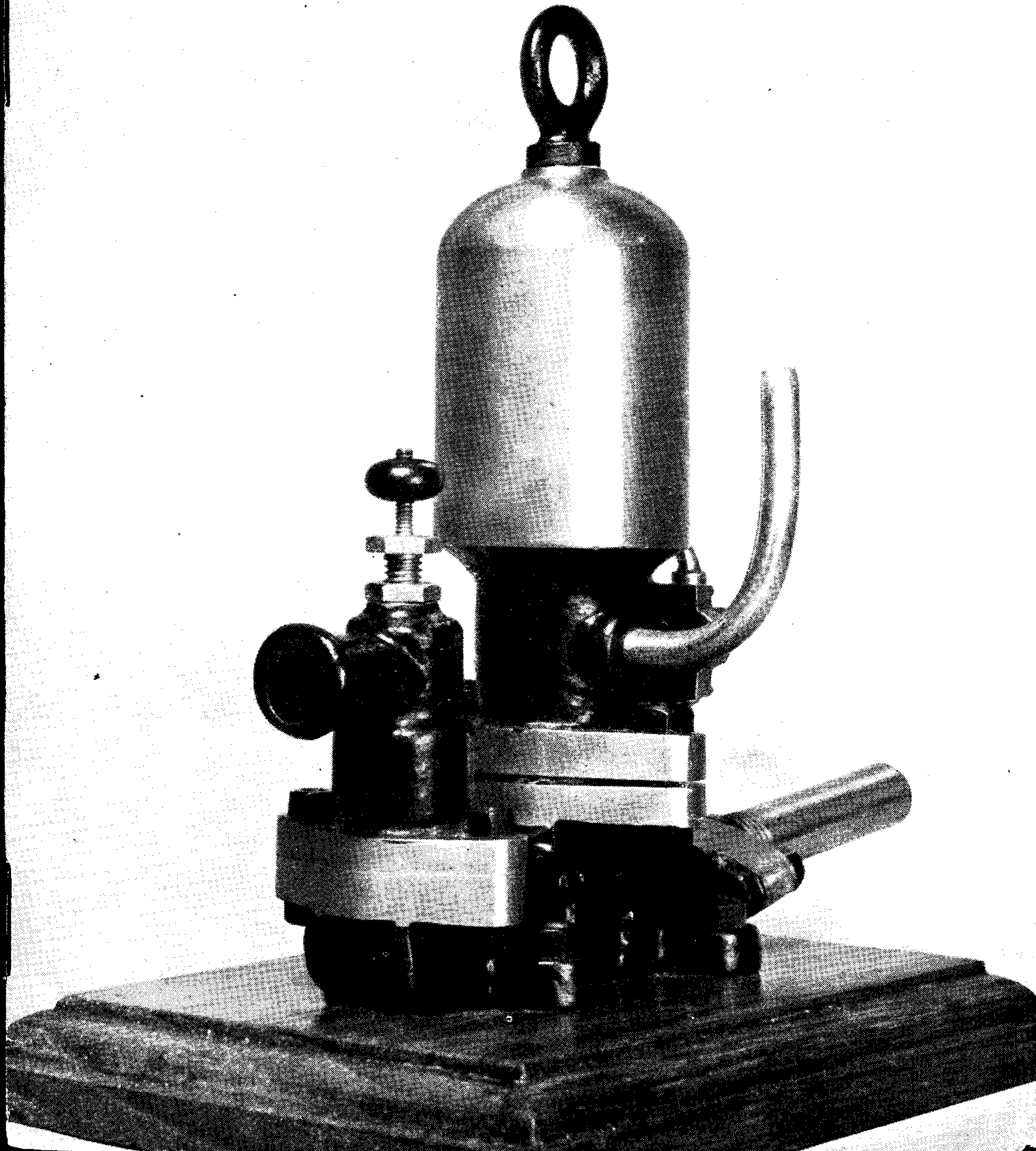
THE MODEL ENGINEER

Vol. 102 No. 2542 THURSDAY FEB 9 1950 9d.



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

9TH FEBRUARY, 1950 VOL. 102 NO. 2542

SMOKE RINGS

Our Cover Picture

● THE MODEL shown this week represents a piece of mechanism which is not very common at the present day, and it is possible that many of our readers may fail to recognise it. The model was sent to us by Mr. H. C. Sturla, who is probably known to many of our readers for the production of small castings. This particular model is believed to have been made by his father, who was interested in the construction of various types of model pumps, and he concludes, therefore, that this is a model of some kind of pump, though he has been unable to find its particular function and purpose. From a close examination of the model, however, we are fairly certain that it is a model of a hydraulic ram, and is presumably intended to be a working model. For the benefit of readers not familiar with this type of mechanism, it may be described as a form of pump which utilises the kinetic energy of water running through the main passage at a comparatively low head, to pump a small quantity of water to a very much larger head. This form of pump has been used extensively in the past as a very simple and trouble-free means of pumping water, in cases where a spring or stream with a moderate fall is available. Water enters the chamber of the ram through an inlet pipe seen on the right of the picture, and is allowed to flow freely through the outlet pipe, in which is situated a weight or spring-loaded impact-valve, opening downwards, and normally kept open against static pressure. When the momentum of the water reaches a certain figure, it overcomes the weight or loading of the valve and causes it to close suddenly, with the result that the water rebounds and causes an increase of pressure in the chamber. A lift-valve situated below the air vessel is thereby opened, and a small quantity of water ejected forcibly into the vessel, and thence to the outlet pipe, which projects vertically from the chamber. The air in the vessel acts as a cushioning device to prevent water-hammer in the delivery pipe, and is practically indispensable to the efficient working of the ram. After the initial surge of pressure, a reaction or "rebound effect" takes place, lowering the pressure in the main chamber and allowing the impact valve to open again. The cycle of operations is thereupon repeated indefinitely, usually at intervals of a few seconds. One interesting feature of this particular model is that the impact-valve is fitted with tangential vanes on the underside, which are presumably intended to cause it to rotate and distribute wear evenly over the seating. Articles on the design and construction of hydraulic rams appeared in early issues of THE MODEL ENGINEER, and we know of at least one reader who succeeded in irrigating a large estate by means of a ram built from instructions contained in our pages.

From an East Horsley Reader

● MR. J. WILSON, JNR., has written to us to enquire into the possibility of forming a model engineering club in the neighbourhood of East Horsley. His letter goes on: "I am, myself, an enthusiastic reader of THE MODEL ENGINEER and glean most useful information and guidance from its pages, but to have a club where the practical side of things may be discussed to the benefit of all members is truly a great asset."

Of course, we agree; but in our reply we reminded Mr. Wilson that there is a well-established model engineering society in Guildford, which is not very far from East Horsley and might meet his requirements. However, this does not mean that we are blind to the fact that a club much more nearly to hand might be more desirable and convenient, from several points of view. The question really depends upon whether a large enough number of members is available to ensure the success of such a club; we are not prepared to answer this question off-hand, as we have no direct information as to how many of our readers live in or within easy reach of East Horsley. Possibly, there are several "M.E." readers in that district; also, they, or most of them, may already belong to the Guildford society. Even if this is the case, there is still the possibility that Mr. Wilson's idea could be met in another way; we suggest that there is no absolute necessity to form a club, or society, in the usual sense of these words. If local enthusiasts knew each other personally, periodic meetings at their individual homes, or some other convenient place, could be fairly easily arranged, and without the formalities—however informal these may be!—usually to be observed by members of a society.

With this idea in view, and in the hope that any interested readers would favour such a scheme, we are giving Mr. Wilson's full address, which is: "Arran," Nightingale Avenue, East Horsley, Surrey.

The Buffer-beam Did It!

● WE HAVE received another interesting letter from a reader in New Zealand, this time Mr. H. E. Clow, of Hawkes Bay, who has been in that country for two years, though he seems to have been a reader of THE MODEL ENGINEER for much longer than that. He mentions that the high cost of tools and the scarcity of materials make model engineering very difficult in New Zealand; nevertheless, stalwart enthusiasts, if few in number, manage to produce some good work.

Mr. Clow relates a strange but happy experience that occurred to him when he had been only a few months in New Zealand. He was waiting for a bus one morning on his way to work when a second potential passenger came up to the bus-stop. Both stood waiting for a while, when the other fellow fumbled in his pocket for tobacco and paper; as he brought them out, a piece of metal fell to the ground, and Mr. Clow picked it up to find, to his surprise, that it was a buffer-beam for a locomotive! After that, of course, another model engineer friendship was quickly formed and has persisted ever since.

The Hundredth Issue of The Central

● OF THE many contemporary house journals issued by various colleges and technical institutes in Britain, *The Central*, the journal of the Old Students of the City and Guilds College, is certainly one of the foremost. We are glad to offer to its Editorial Board our heartiest congratulations upon the production of its hundredth issue. The principal contents, naturally, are of a reminiscent nature; but there are cordial messages of congratulations and greetings from eminent personalities who are members of the Central Technical College Association, from the Lord Mayor of London and from City Guilds.

Although an excellent quality of paper is used for the 74 pages of articles, notes and announcements, the illustrations are printed on heavy art-paper inserts, and the whole production is fully in keeping with the occasion. The cover is very striking; it consists of a heraldic design incorporating the coats-of-arms of the Corporation of London and the twelve great Guilds, or City Companies, printed in colours.

We are grateful to note the memoir of the late Percival Marshall, whose interest in his old college and all connected with it never dimmed.

Model Exhibits in Bradford Museum

● THE "TRACTION ENGINES" exhibit at the Cartwright Memorial Hall Museum, Bradford, has now been replaced by one entitled "Cornish Pithead Gear." Planned to illustrate the type of gear formerly used at tin and copper mines in Cornwall, the exhibit contains three models built and lent by Mr. Frank D. Woodall, of 178, Bradford Road, Shipley, whose good work on the history of Cornish mining machinery is well known to readers of THE MODEL ENGINEER.

One model shows an engine house with a beam engine providing power for raising the pit cage. In the centre is the actual pit head, with the cage just coming to the surface, while the third model is of the stamp mill, driven by another beam engine.

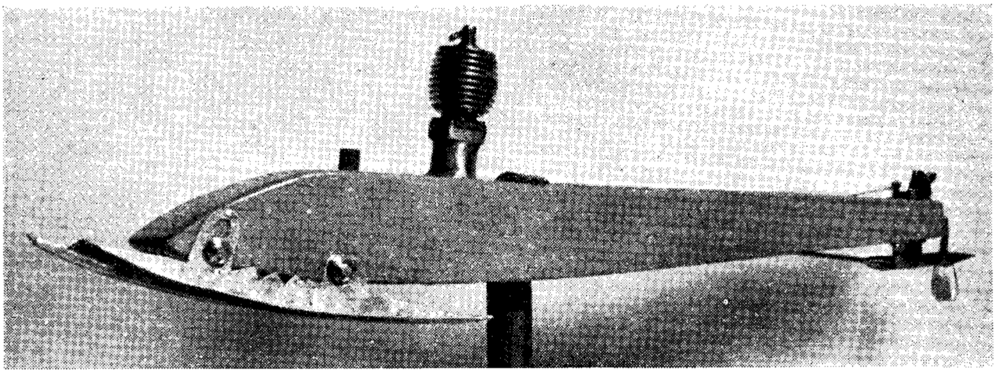
Specimens of tin and copper ores, and photographs of old Cornish mines, are also included in the exhibit, which is to remain on view until June 30th.

Removable Boiler Flues

● A VERY large number of readers have written to us with reference to Mr. V. H. Messer's illustrations and brief notes relating to the Robey portable engine with removable flues. We would offer cordial thanks our to all correspondents on this subject, and we regret that we cannot possibly spare the space in which to publish all the letters.

It is clear that such boilers were made by other manufacturers, especially Messrs. Lachapelle, of Paris, and Messrs. Marshall in this country, for use in countries where the water was dirty.

But, with particular reference to Mr. Messer's notes, we feel that we owe him some apology for not having modified his statement that Robey's "did not, it seems, build traction engines." This statement, which we unfortunately omitted to qualify, produced quite an avalanche of denials!



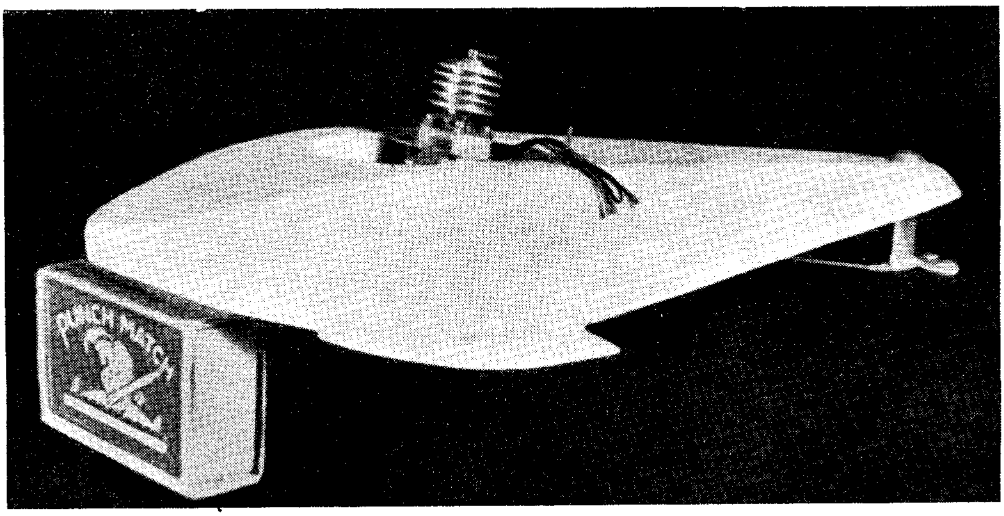
The present hull with the 0.6 *c.c. engine and temporary sponsons used in first trials*

A 0·6 c.c. "Diesel"-Driven Hydroplane

by "E.M.E."

THIS story really started when the first news of the model compression ignition engine became known in this country. Previously, I had regarded flash steam as the only solution for the motive power for a really small hydroplane, and after about two years' work on *Dot III*, *IV*, and *V* (described in THE MODEL ENGINEER, January 4th, 1945 and April 18th, 1946) a fair measure of success, with speeds up to 15 m.p.h. had been obtained with these 10 in. long boats. After getting as much information on the small diesel as I could, a design was evolved for one of 0.3 c.c. ($\frac{1}{4}$-in. bore × $\frac{3}{8}$-in. stroke) and after a week's work in December, 1946, the engine was ready for a trial. After half an hour's work with the starting cord, I got a "pop" from the exhaust—until then I could not believe such a small cylinder could fire. A few more pulls over, and it actually ran by itself, but only for about 10 secs., after which the connecting-rod folded up. It took a further two weeks or so before the engine design was modified to obtain satisfactory running; it developed about 0.012 b.h.p. at 7,000 r.p.m. and weighed about 1 oz. with a 6-in. airscrew. The engine was then fitted with a flywheel and ratchet starter, and installed in a 10-in. hydroplane. This was seen in action on the water at the 1947 MODEL ENGINEER Exhibition. Its best speed was around 10 m.p.h., but the ratchet starter caused no end of trouble.

Subsequently, diesels of 0.1 c.c., 0.07 c.c. and



The first hull with 0.3 *c.c. Diesel engine*

0.033 c.c., were constructed, the only reason being my mania for the ultra small engine; they all performed in a satisfactory manner, and certainly I got all the practice I needed in the art of lapping.

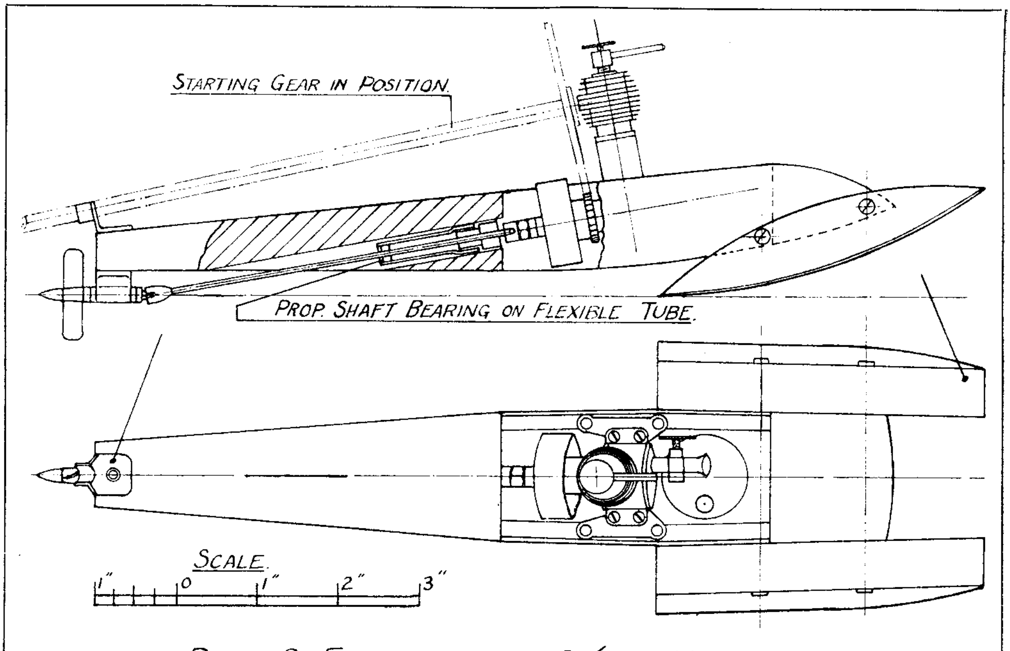
It then occurred to me that a 0.3 c.c. engine was too small for real speed with a 10-in. hydroplane. A 0.4 c.c. diesel was then made ($\frac{1}{4}$-in. bore × .45-in. stroke) as I thought a really long stroke was desirable for easy starting. The inlet valve was arranged as shown in the drawing and the starting pulley attached to the end of valve shaft, to simplify the job of threading the starting cord round it. This engine was fitted to the same hull, but performance was not so good, and starting was still difficult. I am inclined to believe that the scavenge efficiency might be the explanation, due to the long stroke; making the sunk deflectors deeper did not improve matters, probably because of the adverse effect on the combustion chamber shape. By this time, the surface propeller was becoming popular so the whole job was dismantled, and the design of the present hydroplane was worked out.

Hull Design

The drawing of the hull shows the main features of design; it is just large enough to keep itself afloat (with engine, etc., of course) when stationary, so as to prevent air-lift causing a loop-the-loop. It is made of soft balsa, covered with 1 m.m. three-ply. Adjustable temporary aluminium planes were fitted for trial purposes (in this condition, the boat would *not* float when stationary).

Transmission

The propeller shaft is supported in universal joints at each end; to prevent flooding the engine compartment when the boat stops, a central bearing is supported by a flexible plastic tube. I believe that many boats waste power in transmission if there is a central bearing on the propeller shaft fixed rigidly to the hull. However, well it may be lined up when made, one can never guarantee that the shaft will remain straight, or the hull undistorted. The shaft is $\frac{1}{16}$ in. diameter stainless steel, and its first critical speed, 14,800 r.p.m. (neglecting the slight steadying effect of the central bearing).



PLAN & ELEVATION OF 0·6 C.C. HYDROPLANE.

Propeller

The diameter of the propeller is $1\frac{1}{8}$ in., maximum blade width 0.3 in., and pitch approximately $4\frac{1}{2}$ in. The thrust line passes through the trailing edge of the sponsons. Rotation is anti-clockwise looking at the stern. A thrust washer of laminated plastic is used, and the skeg bracket is hollow, forming an oil reservoir for lubrication.

Engine

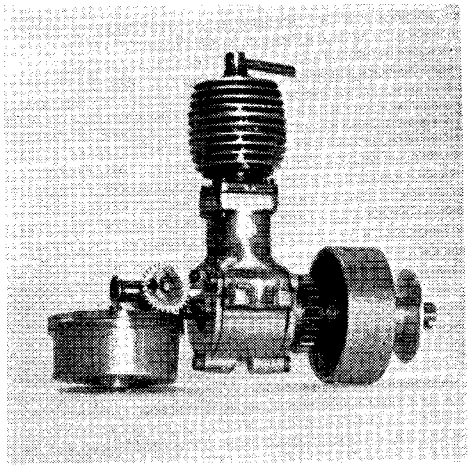
The previous 0.4 c.c. engine crankcase was used again, the part forming the cylinder " skirt " being bored out as large as possible, and a new cylinder made, of .325-in. bore. The cylinder follows a design I have used with success on many diesels; the barrel is of carbon steel, with a mild-steel flange brazed on about half way up. After brazing, the whole is quenched out in water, and stress relieved in boiling water to retain maximum hardness. The ports are symmetrical, which avoids any action tending to produce a

" warped " bore when lapping. The joint surface of the mild-steel flange is skimmed up true after brazing and lapping. The lower part of the cylinder is a clearance fit in the crankcase, thus there is no chance of mechanical forces distorting the bore on assembly, and a gas-tight fit is easy to ensure between the flat joint surface. By arranging the transfer passages on each side, clearance for the connecting rod is also obtained. The piston has a duralumin yoke screwed in, this saves trouble caused by the gudgeon pin fouling the ports, and simplifies lapping, as the cylindrical surface is unbroken except for the small hole for the locking screw. The sunk deflectors are ground in with a wheel 1/10 in. thick after lapping, and are kept very small to avoid spoiling the shape of the combustion space.

A new front cover, with the normal type of disc rotary valve, was fitted. The attachment of the fuel tank to the choke tube may appear unnecessarily cumbersome, but it has the very real advantage that the whole tank may be removed without disturbing the engine in the boat, very useful when a fuel block occurs just when one wants to show a friend how good the boat is.

The compression adjustment also has some unusual features. On previous engines, contra-pistons have occasionally seized up ; the adjusting screw on this engine adjusts positively both ways. There is also a pressure release valve, which is very useful in discharging water after a capsize. Incidentally, one strange feature of a previous boat was traced back to cumulative contamination of the fuel by water ; the perspex lid to the fuel tank soon shows up any water bubbles in the fuel.

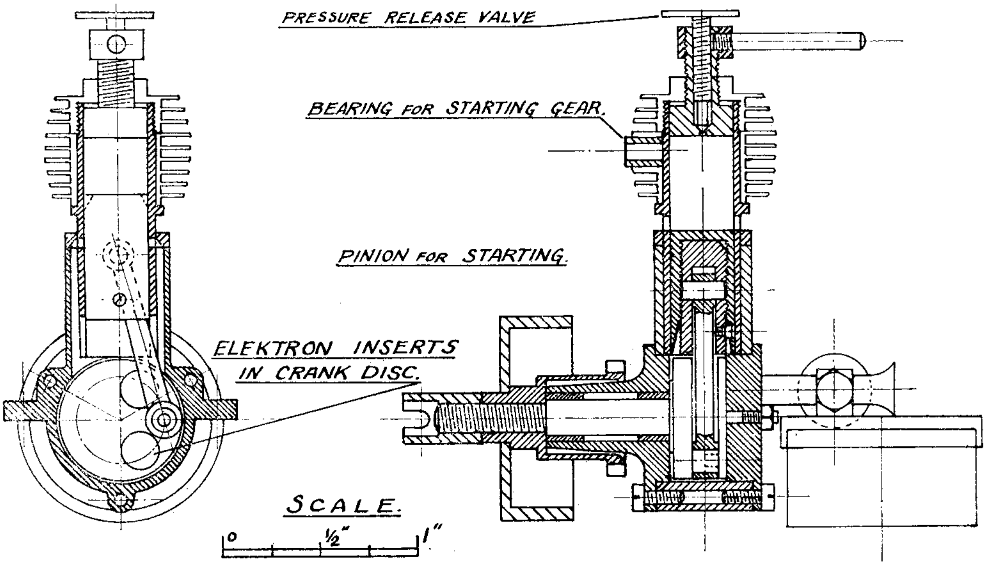
There is little more to be said about the engine that cannot be seen from the drawings, except for the materials. The crankshaft is of mild-steel and case-hardened ; it has, however, been once " reclaimed " by chromium deposition, as has also the piston. The bearings are of hardened carbon steel, and also the connecting-rod, the latter item being tempered heavily between the bearings. The crankcase and both endplates are of duralumin, cut from the solid.



The 0.6 c.c. engine before fitting final contra-piston and release valve, and removing the starter pulley

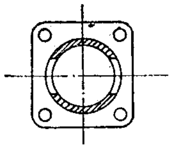
Starting Gear

This consists of a $\frac{3}{16}$-in. diameter steel rod which carries a handle at one end, and a large gear wheel, mounted on a ratchet gear (similar to a cycle freewheel). This starter is " plugged-in " to a bearing at the rear of the cylinder, the other end of the shaft being supported in a half

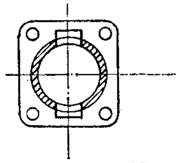


SECTIONAL ELEVATIONS OF 0·6 CC. DIESEL IN PRESENT FORM

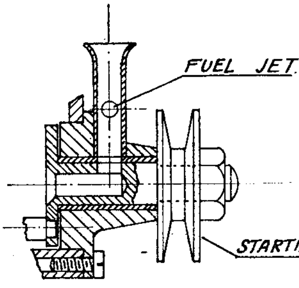
bearing at the stern. The large gear meshes with a pinion integral with the flywheel. On rotating the handle, the engine is turned over rapidly (gear ratio 5 : 1), and when it starts up, the large gear "freewheels" and the starter can be removed. This method adds very little to the weight of the boat, and is extremely robust; also it is much quicker than trying to thread a starting cord round the flywheel of a small boat; but the most important item to my mind is that one person can start up without assistance.



SECTION THROUGH EXHAUST PORTS.



SECTION THROUGH TRANSFER PORTS.



ORIGINAL ROTARY INLET VALVE.

Performance

The boat was first tested with adjustable aluminium sponsons. A little practice was needed to get it away without stalling; it seems impossible that a surface propeller can drive when held in the water, as no "push" at all can be felt, unless the propeller is submerged, when the engine will stall. Still a few moments' consideration shows that conditions at even a moderate speed are very different from stationary conditions. Having obtained one nearly satisfactory launch, my next attempt was successful—until I looked closely and found that the forward bridle cord had got entangled with the sponson, and the boat was performing quite well supported by the other one only. Of course, this could only occur on a very short course; actually 11 ft. 6 in. diameter at the time.

Having eventually mastered the art of launching, planing angles, etc., were altered, and the temporary propeller blades twisted to various angles during tests. The best speed reached on test was 17.7 m.p.h. with planing angle almost washed out at the tips. Any increase in planing angle decreased the stability. The final pair of sponsons were then made of balsa, with 1 mm. three-ply covering, and fixed to the hull. Subsequent results show that the peak performance is 20 m.p.h., but to achieve this result, launching is very critical, and I can only manage it after about four or five attempts. At this speed, on really smooth water, the sponson tips are, as far as I can see, completely airborne about $\frac{1}{4}$ in. above the water, but I have not yet had the front lift sufficiently to cause overturning, although the boat has occasionally nose-dived in rough water.

Good Bench Performance

Unfortunately, I was unable to get this boat going at the 1949 exhibition, as the engine had been hurriedly assembled after refitting, and needed running in before it would start in the boat, owing to the very light flywheel. Having had a test run on the bench, I presumed it would start satisfactorily in the boat; but, as most power boat men know only too well, engines always perform well on the bench.

The photographs of the engine alone, and the first hull with 0.3 c.c. engine are the work of Mr. L. O'Connell, and that of the present hull with temporary sponsons is by Mr. Biffin, who is a member of the Kent Model Engineering Society.

Home Soldering Kit

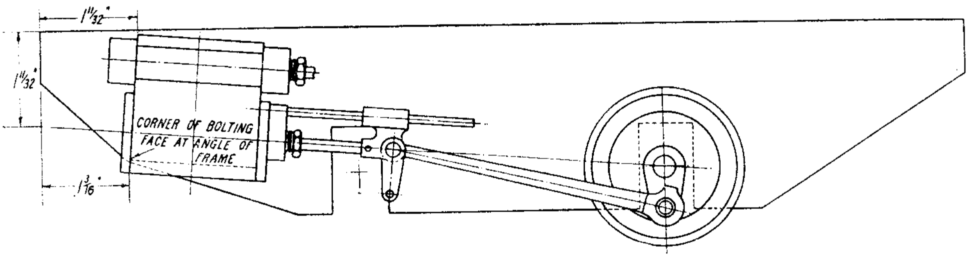
We have examined and tested the very handy 2s. Multicore Home Soldering Kit in which four types of solders are supplied, viz:—Model makers' quality and Metal Mending quality with Arax cores, Electricians' and Radio-Television quality with Ersin cores. Ersin solder contains three cores of flux which is a high-grade resin activated by a chemical process. The residue sets hard and has a high insulation value. It is entirely non-corrosive. Arax solder contains two cores of flux, the residue of which is removable with warm water. This type should not be used for wire to tag joints in radio or electrical equipment, as, although the flux is acid free in dry condition, the residue will absorb moisture from the atmosphere and upon decomposing will become mildly acidic.

The makers, Multicore Solders Ltd., Mellier House, Albemarle Street, London, W.1, supply leaflets giving particulars of their full range.

"L.B.S.C.'s" Beginners' Corner

Guide Bars for "Tich"

BEFORE erecting the cylinders on the frames, we need the guide-bars, crossheads, and connecting-rods; the whole lot go up together. The guide-bars are only two bits of $\frac{1}{8}$-in. by $\frac{3}{16}$-in. silver-steel with a screw at one end, for attaching to the gland boss, and a countersunk hole at the other end, to take the screw holding the outer ends to the link bracket. Saw off the two pieces a shade over length; then chuck truly in the four-jaw. This job seems a bit of a headache to many beginners, yet it is easy enough when done as follows. Set it as near as you can "by eye," closing the jaws on the piece of rod so that each one comes, as near as you can judge, to the centre of the width of the metal. One of my own four-jaw chucks has jaws just $\frac{1}{8}$ in. wide at the gripping end; so if I want to chuck a piece of rod that width, all I do is to set it flush with the jaws. Pull the belt by hand, and run up the end of your knife tool in the slide-rest until it touches the rod. If it touches all four corners, the rod is set O.K. If it only touches one, slack the two opposite jaws very slightly, and tighten up the two on the "touching side," which will throw the work over a shade. If the tool touches two corners, slack the one opposite jaw only, and tighten up the one between the touched corners. You'll get the knack of setting truly, after a few shots, and probably need only one or two adjustments in each direction, after that. Incidentally, one of my old "Kaiser's war" munition girls had a marvellous eye for four-jaw chucking, and could set a dozen pieces "spot on," one after the other. Whether the fact that she could play any piece of music on the piano, at sight, had anything to do with it, I don't know; but anyway, there it was. Some folk are "gifted" that way.



How to erect cylinder, crosshead and connecting-rod

Cutting Fluids

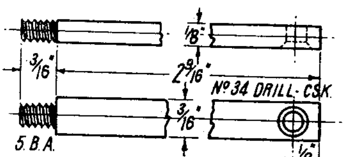
Face the end of the rod, then turn down $\frac{3}{16}$ in. length to $\frac{1}{8}$ in. diameter, and screw it 5-B.A. to match the tapped hole in the gland boss. Old-time toolmakers who had occasion to turn cast steel (silver-steel is only "glorified" cast steel) always reckoned that turps was the finest cutting fluid for that metal; but personally, I just use the same kind of cutting oil ("Cutmax" diluted with paraffin) as for ordinary steel, both for turning and screwing, and get an excellent finish. Use the tailstock holder for the die; don't be tempted to use the hand die-stock, as I've known plenty of "L-card merchants" to do. If the threads aren't true, the guide-bars won't come parallel with the piston-rods. After screwing, reverse the bar in the chuck, and face the other end until it is exactly $2\frac{9}{16}$ in. from shoulder to end. If you slack No. 1 and 2 jaws, and re-tighten the same two after reversing, the bar will still run truly.

Now screw the bar into the gland boss, and note which is the underside when the bar is right home. Remove bar, make a centre-pop at $\frac{1}{8}$ in. from the end, in the middle of the underside, drill it No. 34, and countersink with a $\frac{3}{16}$-in. drill. If you don't screw in the bar, but drill and countersink "on the off-chance," the chances are 1,000 to 1 that the countersink will come on top; and when you try to get the other half-turn, the screw breaks off in the hole, and you've had it, as our R.A.F. friends say. If the bars are now screwed home, they should be parallel with the piston-rods.

Crossheads

Though the crossheads on full-size engines are made from steel, it would be easier for beginners to make these from bronze or gunmetal; but steel may, of course, be used if preferred. A piece of metal $\frac{5}{16}$ in. thick, $\frac{3}{4}$ in. wide, and $1\frac{1}{2}$ in. long, will make the two of them. Maybe our "approved" advertisers will supply a casting, which could be nickel-bronze (German silver) for the sake of appearance. Now, in making these crossheads, beginners will be able to put to good use the lessons they have already learned in making the previously-described components. The first thing to do, is to mill a groove the full length of one of the narrow edges. This groove is $\frac{3}{16}$ in. wide and $\frac{1}{8}$ in. deep, to fit the guide-bar. It can be machined by any of the methods described for milling the rebates

at each side of the axleboxes. The way I personally prefer, is "straight" milling. If you own, or have the use of a milling machine the job is just the proverbial "piece of cake"; for all you have to do, is to put the piece of metal in the machine-vice on the miller table, adjust the table so that the $\frac{3}{16}$-in. saw-type cutter on the arbor will cut a groove $\frac{1}{8}$-in. deep, slap in the centre of the narrow side of the bit of bar (or casting, as the case may be) and go right ahead



Guide bars

Incidentally, I never measure my depth of cut; always trust the machine, and it never fails. This is how:—The spindle operating the vertical movement of the table, has 10 threads per inch, and is bevel-geared 2-to-1, to the operating handle. This has a collar divided into 50 parts, so that moving the handle one division, raises or lowers the table one-thousandth of an inch. To mill a $\frac{1}{8}$-in. crosshead groove, I just put the blank in the machine-vice on the table; a bit of parallel packing between the blank, and the bottom slide of the vice, ensures the blank being level. Then I raise the table, and pull the belt by hand backwards, until the teeth of the cutter just scrape the blank. The table is then traversed so that the blank is clear of the cutter; the handle lifting the table is turned $2\frac{1}{2}$ revolutions, equal to 125 thousandths, or $\frac{1}{8}$ in., and the table traversed under the cutter, which takes out the metal to a depth of $\frac{1}{8}$ in. exactly.

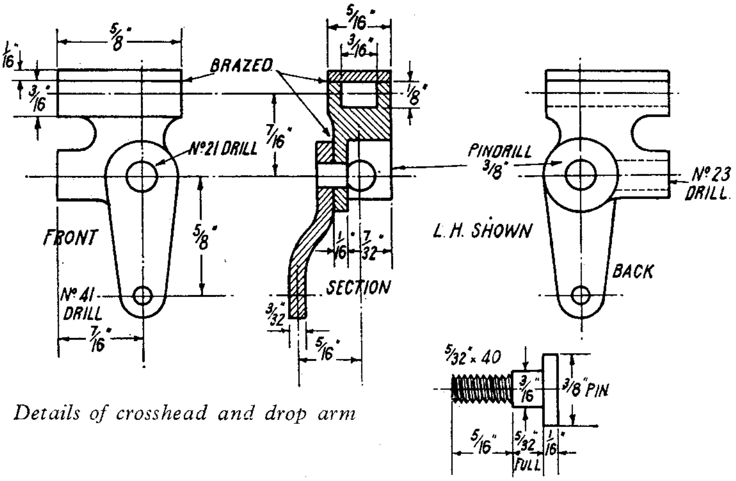
This method of milling can be reproduced on the lathe, by mounting the cutter on a spindle between centres, and clamping the vice to the saddle; but the right height to set the piece of metal in the vice will, of course, have to be measured, as the saddle, won't have any vertical adjustment, unless it happens to be on that very useful machine, the 4-in. Drummond. A modernised version of this, with back gear, would easily lick any of the "fancy" lathes now on the market, for versatility.

The groove can also be formed with a $\frac{1}{8}$-in. end-mill, or home-made slot-drill (which was recently described and illustrated) held in the three-jaw, the blank being clamped on its side under the slide-rest tool-holder, as described and illustrated for milling axleboxes. The groove should be an exact sliding fit for the guide-bar; test with a bit of the same section of steel, and if it doesn't slide, rub the blank up and down a $\frac{3}{16}$-in. square file held in the bench vice, keeping the groove pressed well down on the file. A very few rubs will do the needful. The blank can then be sawn in half, and each half chucked in the four-jaw. Face off the ends, so that the pieces are each $\frac{5}{8}$ in. long.

Next, at $\frac{3}{8}$ in. from the bottom of the groove, or $\frac{1}{2}$ in. from the top, and $\frac{3}{16}$ in. from one end, make a centre-pop. Drill right through with No. 21 drill, using either drilling machine or lathe, as the hole must go through dead square. Pin-drill this to a depth of 7/32 in. with a $\frac{3}{8}$-in. pin-drill having a 5/32-in. pilot pin; something else I have already described how to make, in detail. Don't forget to pin-drill block No. 2 from the opposite side to which you pin-drilled No. 1, so that one crosshead is right-hand, and one left-hand. The blocks can then be filed to the shape shown, a job needing no description, but merely care and patience. Take 1/32 in. off the side opposite to the pin-drilled one, starting at $\frac{3}{16}$ in. from the top, as shown in the section.

Trim off the outer end of each, level with the pin-drilled recess; see back view. The part into which the piston-rod fits can be rounded off if you wish, but it isn't essential.

The next job is the crosshead arm, which operates the combination lever of the valve-gear. Note, this isn't needed if you are using loose eccentrics; it is only for Walschaerts gear. It is filed up from $\frac{3}{8}$-in. by 3/32-in. flat steel,



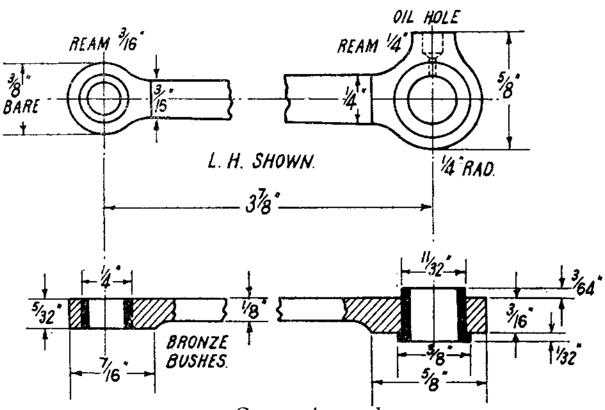
Details of crosshead and drop arm

and bent to the shape shown in the section of the crosshead; drill as shown. Don't bother about exact measurement of the bent part, until the arm is attached to the crosshead. It is best to braze or silver-solder it in place, so that it cannot shift and upset the valve setting. The easiest way to make it "stay put" during the brazing process, is to fix it with a hollow rivet. Chuck a bit of 5/32-in. round rod in three-jaw; this should be of the same kind of metal as the crosshead. Centre, and drill down for about $\frac{1}{2}$ in. depth

with No. 40 drill ; part off two pieces a full 5/32 in. long. Put the drop-arm against the crosshead, put one of the pieces through the holes, put the business end of a centre-punch in the hole at each end of the hollow rivet, and give it a crack with a hammer. This will spread the ends, and the arm will be held securely to the crosshead. Set it at right-angles, as shown in the illustrations.

The tops are made from two bits of the same kind of metal as the crossheads, $\frac{1}{16}$ in. thick, and a little bigger than $\frac{3}{8}$ in. long and $\frac{5}{16}$ in. wide ; they are brazed or silver-soldered on at the same heating as the drop arms. A small tin lid makes a nobby brazing pan for jobs like these, also boiler fittings and other small components. Put some coke breeze or asbestos cubes in it. To prevent the lot falling down among the contents of the pan, lay a piece of asbestos millboard on the coke and put the pieces forming the tops of the crossheads on it. For brazing, use Boron compo for flux ; for silver-soldering, powdered borax or " Easyflo " flux. Steel can be brazed or silver-soldered, as you prefer ; bronze or gunmetal, silver-soldered only. Smear some wet flux on the two strips, also around the joint between drop arm and crosshead. Stand the crossheads upside down in the centre of the strips. Heat up to bright red for brazing, medium for silver-soldering, and touch the joints either with a bit of 16-gauge soft brass wire (if steel) or a narrow bit of silver-solder, or " Easyflo " wire, if bronze. Warning : don't use too much, or it will flow inside the joint, and the guide bar won't go through the hole ; you'll have a dickens of a job filing in out, yet retaining the " all-along " fit for the bar. If you *should* be unlucky, however, one good method of cleaning the hole is to square off the end of a couple of inches of silver-steel, same section as used for the bars ; harden and temper it, as described for pin-drills, cutters, etc. ; and drive it through the hole. This will cut away most of the unwanted brazing material inside the hole, and a watchmaker's square file will finish the job if judiciously applied. Steel crossheads can be quenched out in clean water, and bronze or gunmetal ones in acid pickle, either kind being cleaned up afterwards, and the top filed flush with the sides and ends ; also drill out the hollow rivet with a No. 21 drill.

To drill the piston-rod hole in the right place, beginners proceed as follows. Take off the back cylinder cover. Slip the crosshead over the guide-bar, and run it back to the gland, holding it tightly against the gland whilst you poke a No. 22 drill through the gland and stuffing-box, making a deep countersink on the crosshead boss. Remove crosshead, and drill out the countersink with No. 23 drill, using either drilling machine or lathe, and holding the crosshead in a machine-vice either on the drill table or against a drilling-pad in the tailstock barrel. Set the crosshead in the vice by aid of your try-square, so that the hole is drilled dead parallel with the top of the crosshead.



Connecting-rod

The pins are turned from a piece of $\frac{3}{8}$-in. round mild steel ; just a kiddy's practice job. Chuck in three-jaw, face the end, turn down 15/32 in. length to $\frac{3}{16}$ in. diameter, further reduce a bare $\frac{5}{16}$-in. length to 5/32 in. diameter, and screw 5/32 in. by 40. Part off to leave a head $\frac{1}{16}$ in. wide, as shown in the illustration. For the nuts, chuck a piece of $\frac{1}{4}$-in. hexagon rod in three-jaw ; face, centre, drill down about $\frac{1}{2}$ in. with No. 30 drill, tap 5/32 in. by 40, and part off two 5/32 in. slices. Rechuck each and chamfer the corners of the hexagons. Run the tap through again to clear out any burring.

Connecting-rods

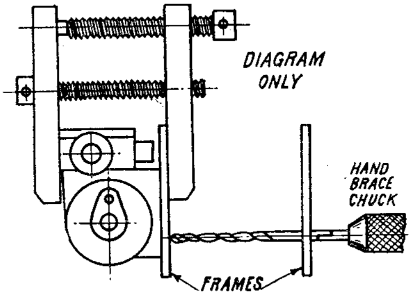
As these are made by exactly the same process as described for the coupling-rods, the lesson learned when making those, is simply applied to the job in hand. The material needed, will be two pieces of $\frac{5}{8}$-in. by $\frac{3}{16}$-in. flat steel. Whereas the coupling-rods are parallel, the connecting-rods are slightly tapered, from $\frac{3}{16}$ in. width at the little end, to $\frac{1}{4}$ in. at the big end. The big-end bush is made and fitted, exactly as described for the coupling-rod bush at the back end of the rod ; but on the inside of the rod, it projects 3/64 in. to form a distance-piece or spacer, keeping the connecting and coupling-rods the right distance apart. The boss or flange on the outside of the rod, is 1/32 in. thick only, as the return crank for driving the valve gear fits outside it. Drill the hole in the big end of the rod, with an 11/32-in. drill, and turn the bush to a tight squeeze fit.

The little end should be just large enough to fit in the recess in the cross-head. It is also reduced in thickness, 1/32 in. being filed or milled off the outside, so that when the rod is fitted in the crosshead, and erected, it will be parallel with the coupling-rod. The hole for the bush is drilled $\frac{1}{4}$ in., and the bush itself is filed

flush each side, and does not project at all. Drill an oil hole in each big-end, as shown by the dotted lines ; and again, don't forget you need one right-hand and one left-hand rod. When finished, put the little end of each connecting-rod into the recess in the proper crosshead, poke the crosshead pin through, and put the nut on outside the drop arm. The large head of the crossshead pin fills the end of the pin-drilled recess, and gives the same effect as if the crosshead were double-sided.

How to Erect the Cylinders

Erecting cylinders correctly is a job that tangles up many a tyro, and even some of the more experienced builders ; a friend managed to get the cylinders of a 4-6-0 erected in such a manner that one was $\frac{3}{16}$ in. higher than the other. If you follow the simple procedure set forth here, you'll find the job easy. The tools needed for the job, consist of a big toolmakers' cramp, which can be home-made, as illustrated some time ago, and a hand-brace with a long No. 30 drill in it. The drill must project not less than $3\frac{3}{8}$ in. from the chuck. These long drills are commercial articles ; I have some of various sizes, but there is no need to buy one specially for the job. Any odd No. 30 drill that you already have, can be lengthened as follows. File a step in the end of the shank, half through the diameter, and $\frac{1}{4}$ in. long, like making a short D-bit. File the end of a piece of $\frac{1}{8}$ in. steel rod, in the same way. Put the two together to form a continuous rod, with the steps interlocking ; tie in position with a bit of thin iron binding wire and braze the joint. The wire binding will probably stick, but it can easily be filed off, and the extension rod cut to proper length.



How to locate cylinder screw holes

Put the crossheads over the guide-bars and enter the piston rods a little way in the crossheads ; then put the cylinder up against the frame, slipping the big-ends over the crankpins at the same time. Put the big cramp in position over cylinder and frame, as shown in the construction sketch. Now adjust the cylinder until the bottom corner of the bolting face is right against the obtuse angle at the front end of the frame ; see dotted lines in the erection illustration. Tilt the cylinder away from the buffer beam, until the front edge of the steam-chest cover is 1 11/32 in. from the front of frame, behind the buffer beam. Tighten the cramp, and then turn the wheels until the piston-rod and connecting-rod are in a straight line. The axlebox should be in correct running position, that is, with the centre of axle $\frac{5}{8}$ in. above the bottom edge of frame. If the connecting-rod passes exactly over the centre of the axle, the cylinder is set O.K. If not, then adjust cylinder until you get the desired result.

"Poke the Drill through the Holes"

See that the cramp is tight ; then poke the drill through the stud- or screw-holes in *both* frames (which was the idea of the long drill) as shown in the illustration, and make countersinks on the bolting face of the cylinder. Remove cylinder, drill out the countersinks with No. 40 drill, and tap $\frac{1}{8}$ in. or 5-B.A. Repeat the whole operation on the other cylinder ; then temporarily secure both to the frame, with three screws in each. Pull the piston rods out of the crosshead bosses, and push them back into the cylinders as far as they will go, until the pistons hit the front covers. Now put each crank on front dead centre. The crosshead bosses will go over the piston-rods again. Keeping the crank on the centre, advance each piston-rod 1/32 in. more, into the crosshead boss ; the easiest way of doing this, is to take off the front cover, and gently tap the piston. If you make a scratch around the piston-rod, 1/32 in. from the crosshead boss, and tap until the scratch is level with the boss, you can't very well fail to get the correct movement. Finally, drill a No. 43 hole clean through crosshead boss and piston-rod ; squeeze in a little bit of 3/32-in. silver-steel, or 13-gauge spoke-wire, with one end very slightly tapered to give it a start, and the job is done. Front covers can then be replaced, and the pistons will just clear the covers by 1/32 in. at each end of the stroke, so no steam will be wasted in filling up large open spaces and blowing to waste. Next stage, that *pons asinorum* of all beginners, the valve-gear ; but if you follow the words and music, there will be no difficulty in singing the tune !

TO LINCOLNSHIRE SOCIETIES

The Skegness Arts Exhibition is requiring the loan of some models for a time. There have been several good, fully-detailed locomotives by Beeson on view for some time now, but it is felt that some change would be desirable. The models need not be representations of locomotives. There must be several readers within fairly easy reach of Skegness who would be willing to loan good models for this purpose, and they are invited to get into touch with Mr. C. E. Fry, c/o Skegness Steam Laundry Co. Ltd., Dyeing and Dry Cleaning Works, Roman Bank, Skegness, who is ready to provide transport facilities for any models from places all over Lincolnshire. The hon. secretaries of neighbouring model engineering societies might care to take advantage of this opportunity.

*A Battery-Driven Electric Clock

by C. R. Jones

THE plates were made from sheet brass 14-gauge 0.083 in. thick, which was first of all flattened as much as possible. A thickness of $\frac{1}{16}$ in. is shown on the drawings, and probably this is more like the finished thickness, after filing and polishing had been carried out.

A piece of the brass was cut out large enough for the front plate, and was screwed to an old drawing board which had two true edges, which were at right angles.

A vertical line was first drawn, with another horizontal one crossing it, the point of intersection being the centre for the centre wheel spindle, and at a distance of 1 5/32 in. above the last mentioned line another horizontal line was drawn. These horizontal lines overlapped the brass on to the drawing board.

Two points were then marked on the top horizontal line, at a distance of $2\frac{9}{16}$ in. on either side of vertical line, and these points were the centres for striking the two curves on either side of bottom portion of front plate.

All these and other dimensions are shown on the appropriate drawing, together with a list of radii.

Each of the small circles enclosing the striking points, are numbered to correspond with the list, and it is to be hoped that sufficient information has been given for readers to complete the marking out of the front plate.

The brass was then removed from board, and cut out using one of the tension files now on the market, after which the edges were carefully filed up to the scribed lines.

The position of the centre wheel spindle, and other centres had been clearly marked on plate with a sharp centre-punch, all measurements being taken from the centre wheel point.

Having proceeded so far with the front plate, the rear one was taken in hand.

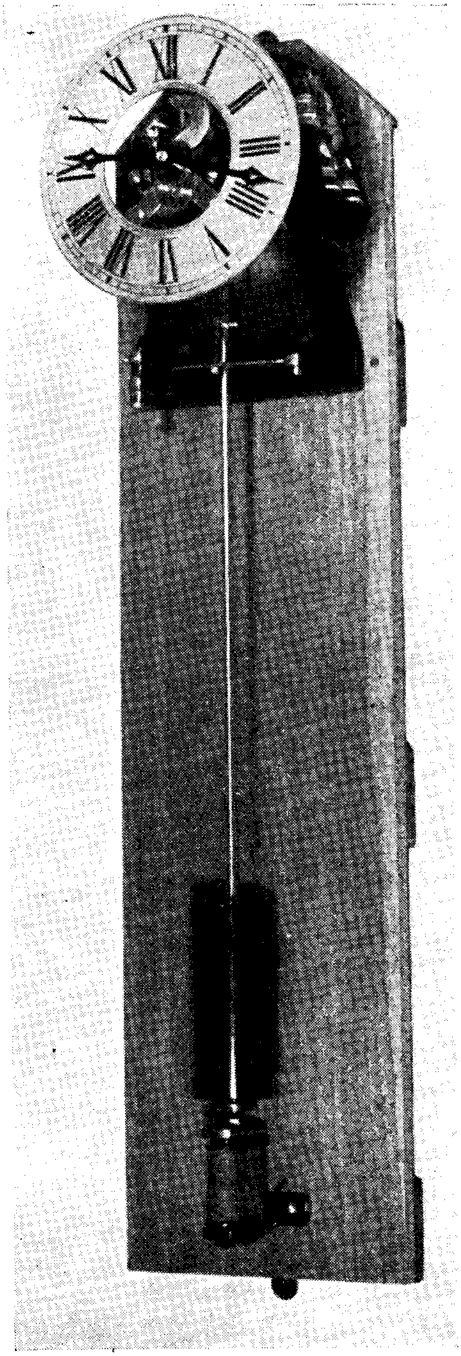
Rear Plate

The brass for the rear plate was mounted on the board the same as for the front one, and marked out in a similar manner.

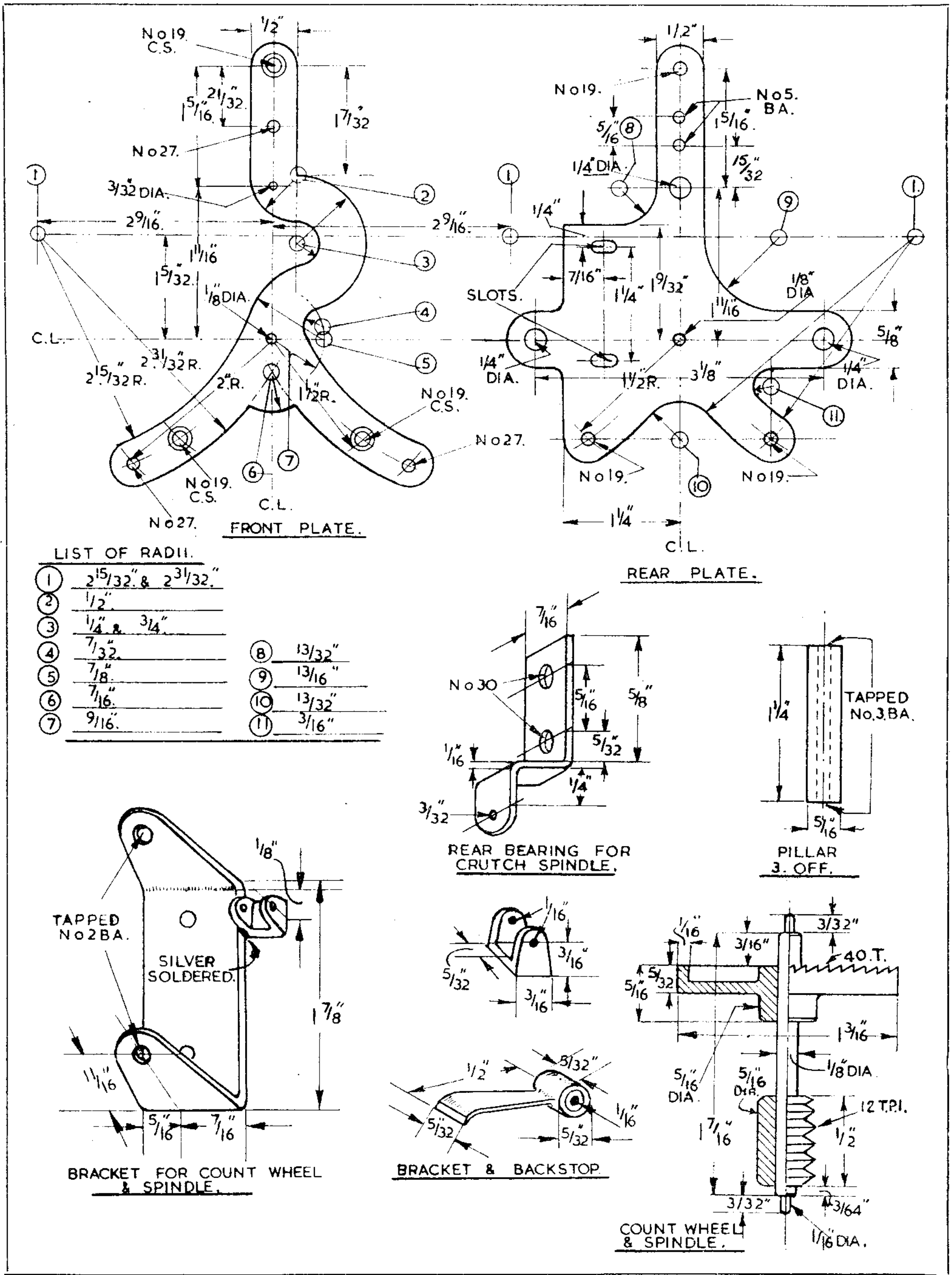
The same method was used for cutting out and finishing. Both plates were then clamped together, and the holes which were common to both, drilled to the sizes shown with the exception that the centre hole, and the 3/32-in. hole above it, were drilled slightly smaller by means of number drills, and these holes were opened out, to fit their respective spindles, by broaching later.

The No. 19 holes in the front plate were countersunk, after which the plates were separated, and the holes which were not common to both, drilled in each, the slots in rear plate being drilled and filed out in the positions shown, clearance for No. 4 B.A.

*Continued from page 145, "M.E." February 2, 1950.



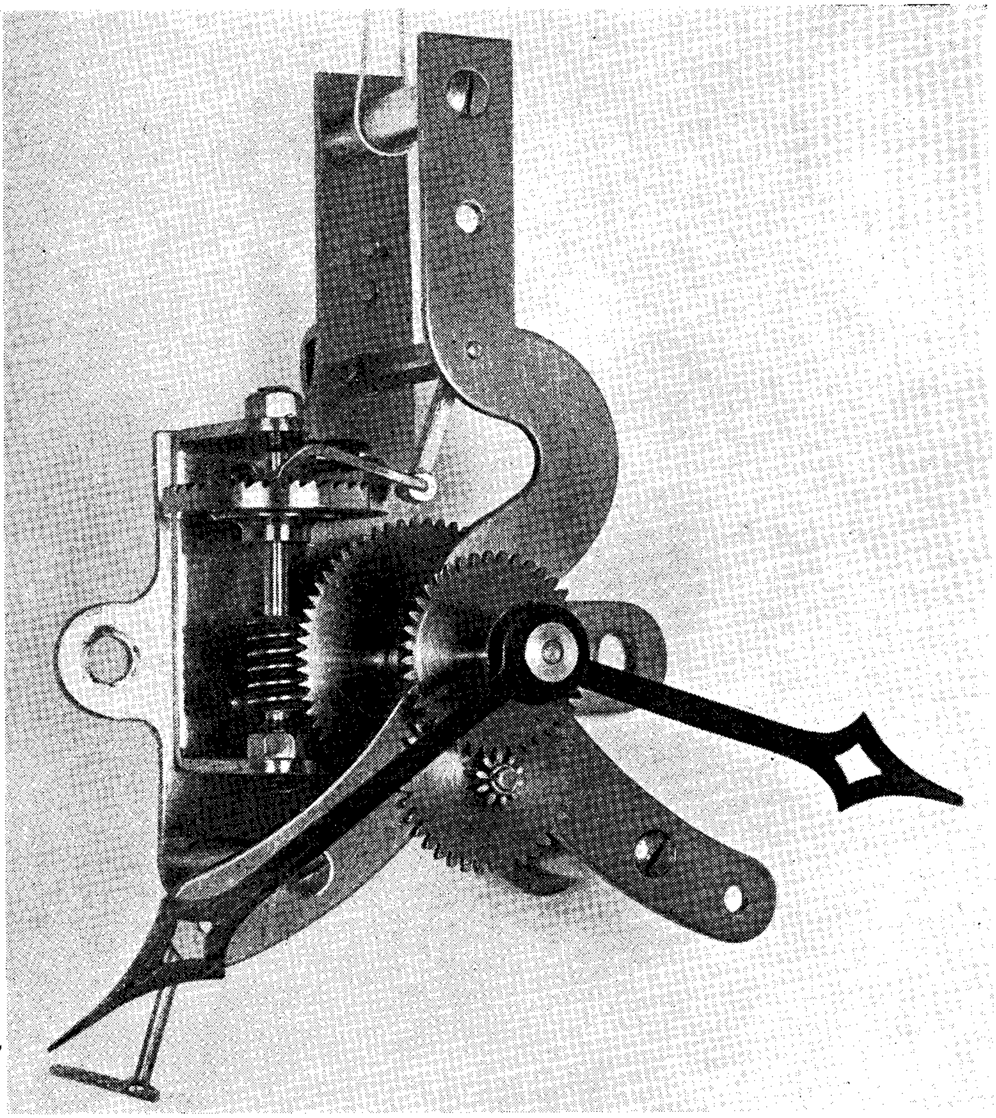
View of clock with case removed



The two holes shown on the drawing of the rear plate, and marked No. 5 B.A. were left until the plates had been fitted together on their separating pillars, and the rear bearing for the crutch spindle had been made together with the spindle. They were then marked off with the spindle in position, the holes in the bracket having been drilled first.

Pillars

These were made from $\frac{5}{16}$ in. diameter mild-steel, the required three lengths being cut off,



View of wheelwork, and front and back plates

and the ends faced off true, to a length of $1\frac{1}{4}$ in.

They were centre drilled and drilled right through from each end, and were also tapped at each end for No. 3-B.A. set-screws.

Bracket for Count Wheel Spindle

The same material was used for making this bracket as for the two plates, and a piece $\frac{3}{4}$ in. wide was bent up at right angles at each end, the outside length being $1\frac{7}{8}$ in.

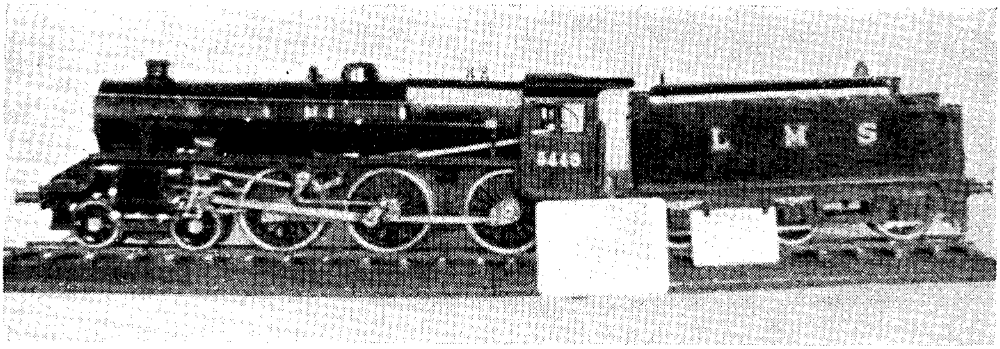
The 2 B.A. tapped holes were marked off on a vertical line $\frac{5}{16}$ in. from the left-hand side of the base, and at a hieght of $\frac{11}{16}$ in. from the base, after this had been finished off flat. The rounded ends were finished off to a radius of $\frac{3}{16}$ in. from the centres of these holes.

Backstop Bracket

This was made from the same material as the previous bracket, and to the sizes shown on the drawing. When filed up and finished off truly, it was placed by the side of the count wheel bracket, on a piece of level firebrick, and silver-soldered as shown.

The centre line of the $\frac{1}{16}$-in. holes were set $\frac{1}{8}$ in. below the inside of the top right-angular portion of count wheel bracket.

(To be continued)



Mr. R. Jacques' 2½-in. gauge L.M.S. Class 5 locomotive

Lincoln Society's Seventh Exhibition

MR. C. V. ARMITAGE, M.I.Mech.E., when opening the seventh exhibition organised by the Lincoln Model Engineering Society, spoke of the amateur model maker in his spare-room workshop and of the love and patience which went into the building of a model. He also spoke of the part played by models in modern industry.

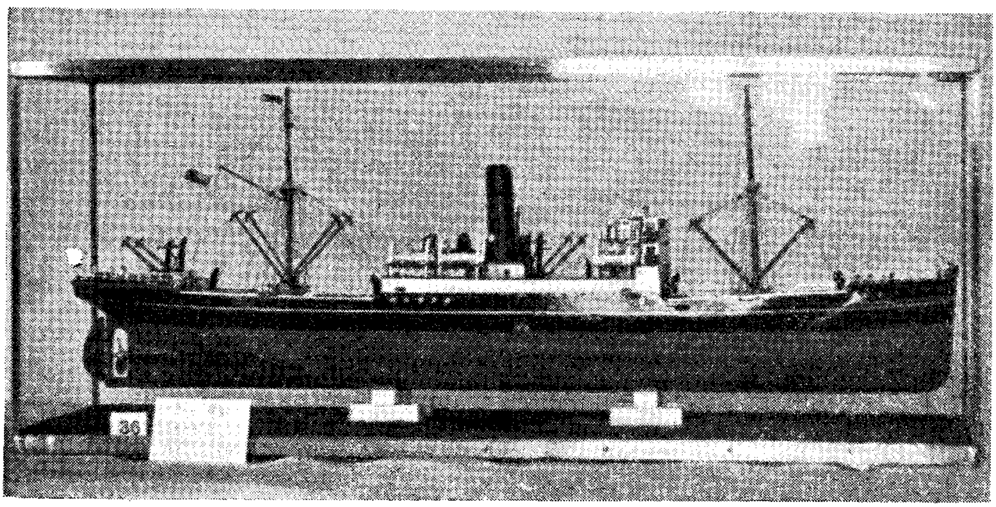
All sections of model engineering were well represented, the locomotive section being by far the strongest, there being over forty locomotives entered, ranging from a 5-in. gauge "Maid of Kent," construction of which is thoroughly well started, to a complete and fully-detailed 2½-in. gauge L.M.S. Class 5 4-6-0.

Principal prize-winners in this section were: Mr. R. Jacques' 2½-in. gauge L.M.S. Class 4-6-0—awarded the Sindal Cup; Mr. W. S. Harrison's 3½-in. gauge "Bantam Cock," and Mr. W. Dyer's 3½-in. gauge "Hielan' Lassie."

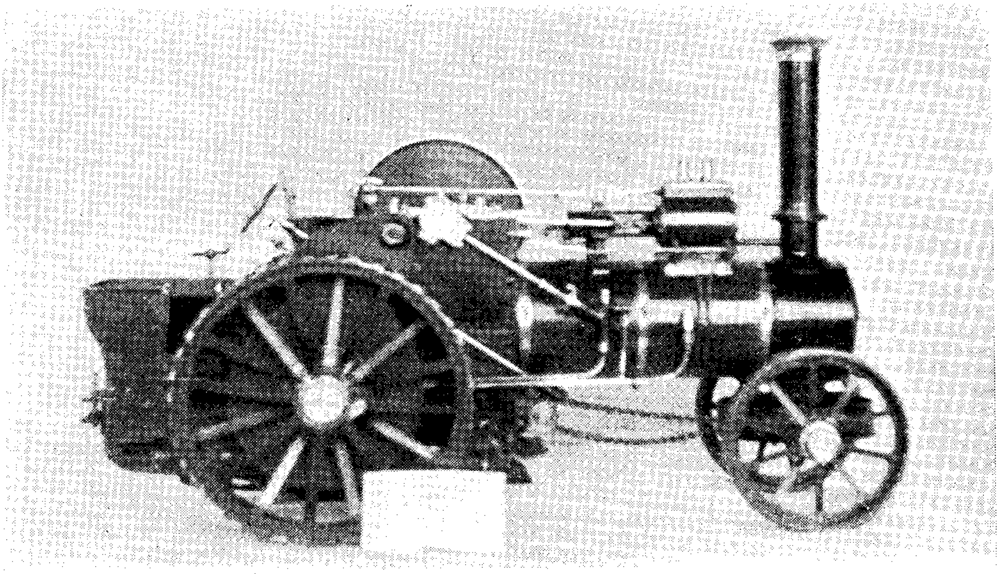
The marine section was also well represented, outstanding among the exhibits were Mr. D. W. Gale's three-mast clipper *Melpomene* which was awarded the Boultham Cup for the finest exhibit in the marine section, and the cargo steamer *Caledonian Monarch*, by the same member, awarded first prize in the powered model class.

The section allotted to tools and workshop appliances was well represented, exhibits included a watchmaker's lathe, sensitive drilling-machine and a dividing head. Prize-winners in this section were: Mr. R. A. Minns' dividing-head; Mr. R. Stephenson's sensitive drilling-machine, and Mr. P. J. Sindal's sensitive drilling-machine.

The model race car section was well represented and all models were really first-class. Prize-winners were: Mr. L. Goodacre's 2.5 c.c. free-lance race car, awarded the Scunthorpe



Mr. D. W. Gale's model cargo steamer, "Caledonian Monarch"



Mr. Walsham's model free-lance traction engine

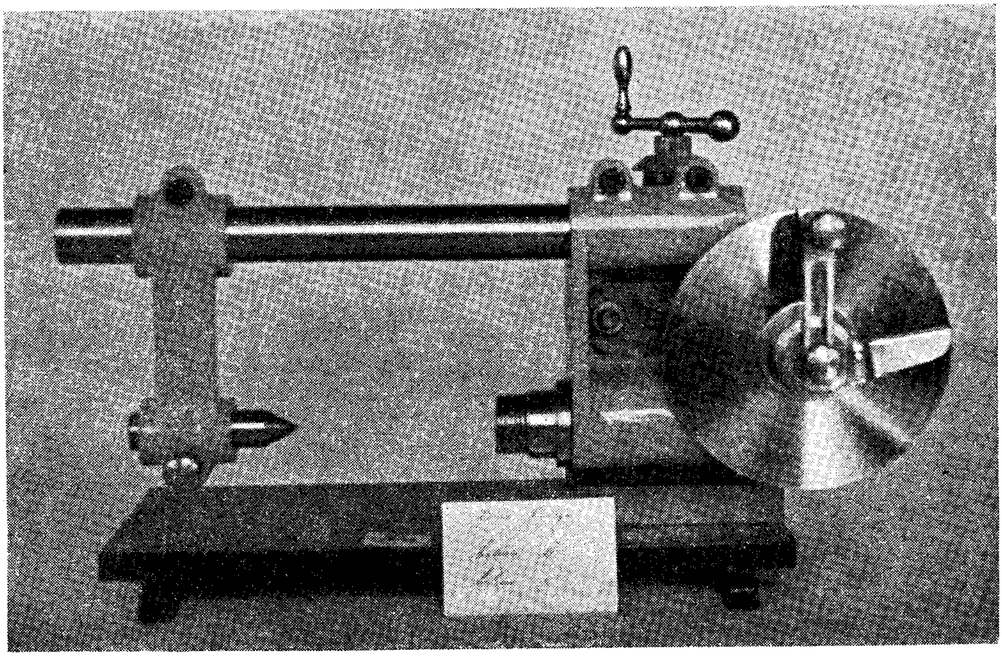
Cup, and Mr. Cartwright's 10-c.c. "M.C.N." Special.

Among the mechanical models exhibited were all the usual vertical and horizontal, single- and multi-cylinder steam engines.

Prize-winners in this section were :

Mr. Walsham's free-lance traction engine awarded the Lindum Cup ; Mr. J. W. Marriott's twin-cylinder marine engine ; Mr. H. Chapman's horizontal mill engine, and a similar exhibit by Mr. D. W. Gale.

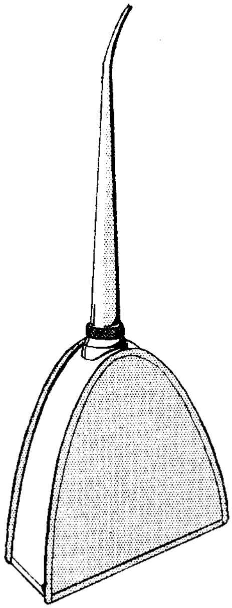
Outstanding exhibits in the miscellaneous section were an electric clock by Mr. J. G. Wilson, and a perpetual calendar for a Congreve clock.



A dividing-head by Mr. R. A. Minns

Novices' Corner

Making an Oilcan



THE following description is of an oilcan which is easily made in the home workshop by the beginner, and one that will be appreciated by all who use it, for it is so designed, that any oil trickling down the spout, will not come in contact with the sides handled when in use, so keeping both the can and the hands clean.

The only materials needed are, two empty condensed milk tins, and a small piece of brass rod. The top and bottom are taken off the tins and a cut made along the join, and then opened out flat.

First, cut two pieces of tin (or to be correct, tinplate) to the size and shape of Fig. 1. Now place them one at a time on a flat and solid surface—an old flat-iron is as good as anything—and stretch the middle part by hammering gently with a light hammer, so as to bulge out the centre a little. It does not need a lot, but just enough to enable you to compress the sides to force out the oil. Now make sure that both pieces are exactly the same size. If they are not, then clamp them together in the vice, and file the edges, not forgetting that there is a right- and left-hand side, so be sure to have the bulges facing outward.

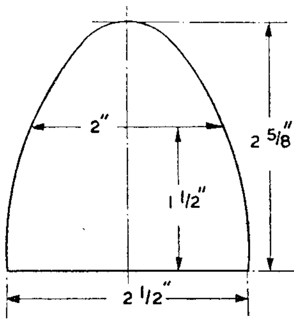


Fig 1

Next, you will need to cut a piece as Fig. 2. This is just a little longer than is necessary, to allow it to be trimmed later. Mark out as dotted lines (Fig. 2) and bend along lines *A*, and bend back at lines *B*. The end view will now look like Fig. 3*A*. All this can be done in the vice, even if it is only 2½ in. wide, by working along from one end. Tap down the edges, over a piece of sheet-iron about twice as thick as the tinplate. The thickness is not important so long as it is thicker. The end view should now look like Fig. 3*B*.

It is best, to bend the whole to a rough " U " shape, and finally to the shape of Fig. 1 so that the sides are a good fit in the grooves already made in the long piece.

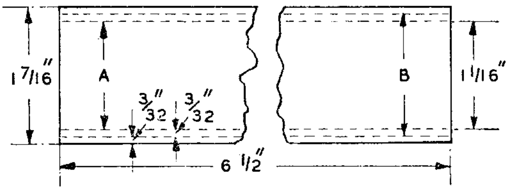


Fig. 2

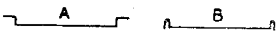
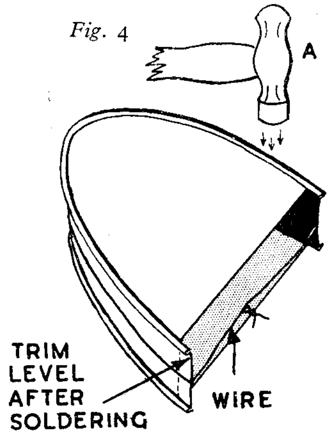


Fig. 3.

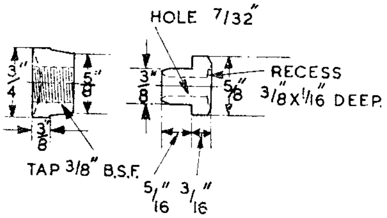
Next is needed a short piece of ¾ in. square iron or mild-steel. Place this in the vice so that about ¼ in. extends beyond end of jaws, and tap down the edge, to form a tight seam all round, which need only be wired up as Fig. 4 so that it will not come out of place whilst it is being soldered. A soldering iron is not needed for this job, a clear flame, from either gas or a methylated spirit lamp providing a better method. To solder, take a 4 in. or 5 in. length of steel, or preferably copper wire and flatten the end with a few sharp blows from a hammer, and this will be your " iron," which is only needed for guiding the solder. If copper wire is used, it will have

Fig. 4



to be poked into a small piece of wood for a handle, as it gets hot much quicker than steel.

Baker's soldering fluid is as good as any flux for this job, and the " iron " need only be dipped into the fluid, and applied to the joint on the *inside*. Cut off two or three nobs of solder, and drop in ; now apply the gas flame to the outside, and when the solder runs, guide it along, with the " iron," moving the can along so that the flame is always where you want it. Of course,



Figs. 5 *and* 6

you will have to hold the can with a pair of pliers, so use your oldest, for the fumes will probably make them rusty. The solder should run right round the join, and just show on the outside. If it does not, then you either have a dirty joint, or not enough heat. In any case, run in a little more solder and " Baker's" (be careful this does not splash into your face, if the can is still hot) afterwards guiding it through by applying the " iron," with a little Baker's fluid on it, to the outside. This should draw the solder right through. Any surplus solder on the inside can be guided to one corner, and, with a sharp tap on the bench, it will drop out, leaving a neat and clean joint. Do one side at a time, and then put to one side to cool. Remember, a tightly hammered joint before soldering is the best. The solder will run right through however, tight it is.

Now take a bit of brass $\frac{3}{4}$ in. diameter, chuck it in the lathe, and turn as Fig. 5. Bore and tap $\frac{3}{8}$ in. B.S.F. and part off. Now file to dotted line to a perfect fit on top of the can. Push the tang end of a file through the top of the can, and

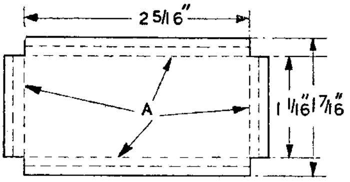


Fig. 7

open out with a half round file to about $\frac{7}{16}$ in. diameter. Tin all round this hole on the outside, also the brass where it is to butt on, and wire it firmly in position on the can, afterwards soldering from inside as before. Make sure that a good bead of solder shows through all round the outside.

If you see any gaps in this bead, close it in with the " iron " whilst still hot.

For the nozzle, chuck another piece of brass, and turn as Fig. 6. Thread outside $\frac{3}{8}$ in. B.S.F. and knurl largest diameter. Bore a 7/32 in. diameter hole right through, part off, reverse, and chuck by thread. It is a good plan—to save turning a nut for holding this in the chuck—to turn this part first, put to one side, and then turn part Fig. 5, which before parting off can be used as a chuck to hold part Fig. 6. Now hollow out recess $\frac{3}{8}$ in. diameter by $\frac{1}{16}$ in. deep (see Fig. 6). If you do not possess a lathe, perhaps a friend will turn these two parts for you.

To fit the bottom first trim the ends of the sides so that all is level. Cut a piece of tin as Fig. 7, first checking measurements on can in case the seams are not in tight. It will be necessary, in this case, to cut the bottom a little longer. It should be a tight fit in the bottom of the can, even if it has to be tapped in with a light hammer Close the seams in the same way as the sides, by hammering tight over the piece of $\frac{3}{4}$-in. square iron. Now put a few drops of Bakers

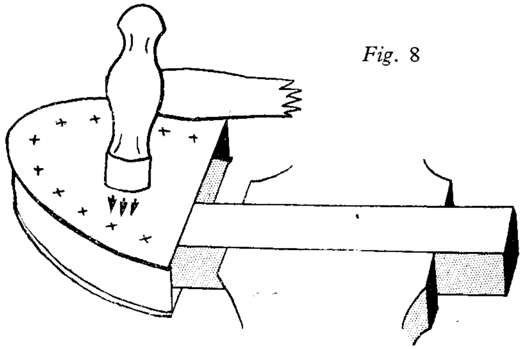


Fig. 8

inside, with two or three bits of solder, and hold over the flame, starting at one corner. When you see the solder just showing on the outside, tilt the can a little, so that the solder runs slowly along, moving the can along the flame at the same time. When cool, you can test for leakage by filling with water, putting your thumb over the top and compressing the sides. Any small leak will show up at once.

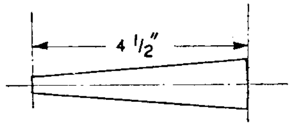


Fig. 9

It is advisable before soldering the bottom, to try the sides by pressing them in, and, on release, they should come out without any help. If they do not, it usually means that you have stretched the centre part too much. If this is the case, remove the bottom, and place can over the $\frac{3}{4}$ in. bar in vice, and tap all round with light taps, as shown in Fig. 8 at spots marked with an x. However, it may only need the seams tapped down by placing the can on a solid flat surface, and tapping with a small hammer, as at *A* Fig. 4. If all is correct, carry on with the soldering.

(*Continued on page* 182)

IN THE WORKSHOP

by "Duplex"

*56—Workshop Drawings

AMONG the readers of these notes there will probably be professional draughtsmen who may not agree with everything that is said, but the intention is primarily to help readers in the preparation of drawings suitable both for reproduction and for workshop use.

The Scale or Size of the Drawing

This is the first and most important point, for the novice may be doubtful as to how large he should make his drawing. As a general rule large components of a piece of mechanism are drawn full size or twice full size in accordance with the amount of dimension lines and figuring which the particular component needs. If the drawings are for publication, the blockmaker will then reduce the drawings to the required size, and this reduction will have the effect of smoothing out any imperfections in drawing, so the larger the original the better will be the printed result.

If the details are of very small components such as special screws and the like, then the originals may be made four times full size since, to give a clear picture, it will be necessary to print the illustrations twice full size. Fig. 6A shows the result of using too small a scale, whilst Fig. 6B shows the effect of drawing to a larger scale. The question of adding dimensions to drawings will be considered later, for the figuring necessary, if not carried out judiciously, will confuse the reader and make the drawing difficult to interpret.

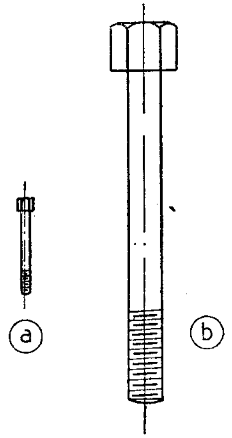


Fig. 6. A bolt drawn, for comparison, (a) full size and (b) four times full size

General Finish of Drawings

The purpose of a drawing is first to present to the reader the actual appearance of the component, and secondly the dimensions and other relevant information. The draughtsman, therefore, should always remember that, although he knows exactly what the component looks like and is familiar with all the details of its construction, the reader will not be so informed. So it is essential to ensure that the drawing does give the reader all necessary information without ambiguity. This entails some embellishment of the drawings themselves, and the avoidance of what may be termed draughtsmen's short cuts.

In a commercial drawing office where time is of paramount importance, the embellishment of a drawing is never carried out, only for some special reason ; indeed, that overworked word utility can best describe the standard of finish. It is not surprising, therefore, that the draughtsman omits to draw in full such details as screw threads, and, in some works, even nuts and bolt heads, but resorts to an abbreviated and time-saving method which may well be understood by the works machinists familiar with such procedure. Those not so familiar may easily become confused.

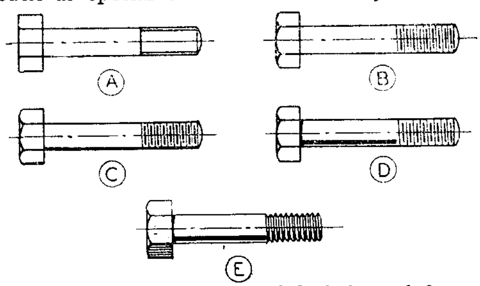


Fig. 7. Five methods of depicting a bolt

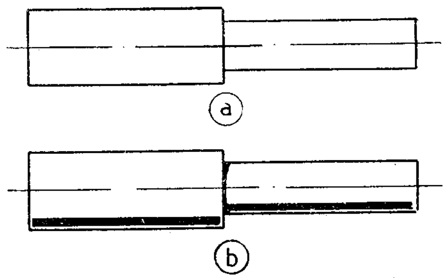


Fig. 8. Showing one method of shading round material

Therefore, whilst it is certainly unnecessary to over-elaborate the drawing, these short cuts should be avoided and conventional text book methods employed when illustrating screw threads, bolt heads and nuts.

Shading Drawings

As a further help in giving emphasis to a drawing, various methods of shading may be employed. In addition, back lining may also be used. By this is meant increasing the thickness of the lower and right-hand edges of the component as drawn, the broad principle being that light is assumed to be falling on the object from some 45 deg. above and to the left of it.

**Continued from page 106, " M.E.," January 26, 1950.*

In general, shading should be carried out on broad and simple lines, and shading which necessitates the use of a number of fine lines used for contrast only, remembering that the lines should be really fine or the results when reproduced will be smudgy.

Fig. 7 shows various methods of depicting a simple bolt varying from the severely utilitarian to what suggests an artist's representation. In these views, progressive stages of shading are employed as well as different methods of representing a screw thread. With the exception of *A*, which is the most severely utilitarian drawing office usage, any may be used for reproduction in the Press, the choice being dictated by the style chosen for the remainder of the drawings. On the whole, style *D* is to be recommended, for it is a rapid and effective means of depicting the original component; note the radial shading under the bolt head, this may be used when drawing shafts with shoulders or in illustrating components with collars.

If a shouldered shaft is drawn as shown in Fig. 8A, the reader may be in some doubt as to what is meant, but if shown as in Fig. 8B there can be no ambiguity whatever. Fig. 8A might well be a component of square section, though strict drawing office procedure requires lines drawn diagonally across the two rectangles before the draughtsman recognises it as such, but there is no mistaking the component in Fig. 8B for anything but a round object. In THE MODEL ENGINEER, for example, the drawings are intended primarily for the amateur who may know little of drawing office procedure. The novice needs a drawing that can be understood at a glance, and if simple methods of shading bring the component to life, so much the better.

Reference has already been made to the use of shading by means of a number of fine lines. It is sometimes necessary to employ this method when drawing components which have a tapering form, and there is considerable risk of spoiling the whole drawing if the shading is not carefully carried out. The effect is obtained by drawing a number of fine lines, which are parallel with each other but with diminishing intervals on the parallel portions of the component and have gradually increasing angles with diminishing intervals where the component tapers. In the latter case, therefore, any change in the location of the centre from which these angular lines radiate will completely ruin the shading.

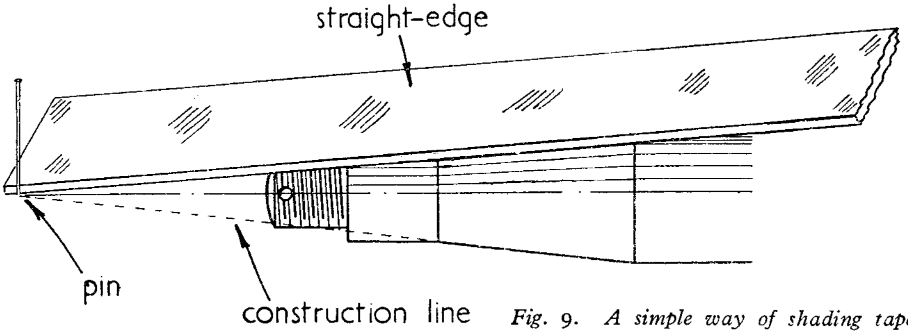


Fig. 9. *A simple way of shading tapers*

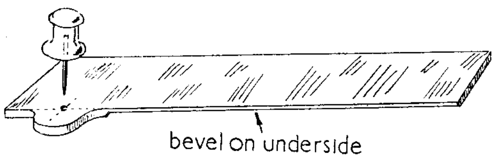


Fig. 10. *Straight-edge and guide pin for shading tapers*

It is useless to try to judge the centre by eye; there is but one way to do this operation, and, fortunately, it is a simple one. Fig. 9 shows a drawing of a motor car stub axle which will serve to demonstrate the method, and for the sake of clarity the arrangement is shown as it would appear if viewed from the edge of the drawing board farthest away from the draughtsman.

The tapered portion of the component subtends an angle with the centre line. A construction line, shown chain dotted, is therefore projected to meet the centre line and at the point of intersection a pin is placed. A straightedge may then be laid against this pin and the shading lines inked in directly. For those who care to make, from celluloid or plastic material, a simple but very effective device for this purpose, Fig. 10 depicts a short straight edge provided with a lug in which a hole is drilled and through which the guide pin can be passed. As will be seen, in this somewhat less primitive device the humble domestic pin can be replaced by one of the glass-headed photographic variety. Alternatively, a suitable pin may be made by fixing a gramophone needle into a turned holder.

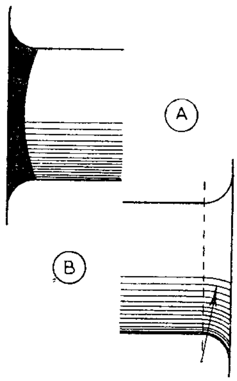


Fig. 11. *Two methods of shading curved shoulders*

As will be seen from reference to Fig. 9, to obtain the desired effect the shading must be drawn in such a way that the end of a line on the

small parallel portion joins on to a corresponding line on the taper part and this line, in turn, links up with a line drawn on the large parallel portion.

Shading of Curved Shoulders

The logical sequence to the method just described is that of shading curved shoulders.

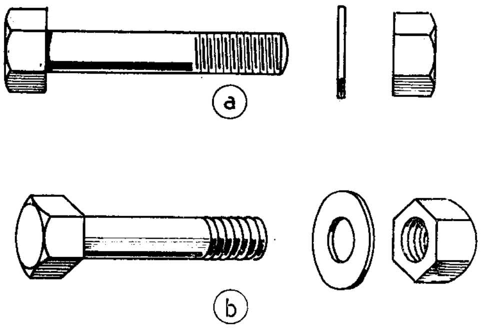


Fig. 12. *Two types of exploded view*

When, as shown in Fig. 11A, the shoulder lies in the position depicted it may be assumed to be in shadow, therefore it is only necessary to indicate this in the manner previously mentioned and now shown in the illustration. But when, as illustrated in Fig. 11B, the shoulder faces in the opposite direction the shading must be carried out with a compass, the needle point of which is placed in the centre used for drawing the curved shoulder itself. A succession of curves is then drawn joining the lines which shade the parallel portion of the component to the line forming the shoulder. It should be noted that the chain-dotted construction line is essential when ruling the parallel lines prior to drawing the curves, for it prevents making the parallel lines too long.

Exploded Views

A general arrangement drawing will usually suffice to show how a particular mechanism is assembled, but what is termed an "exploded view" is often invaluable in demonstrating the construction of the mechanism or some particular

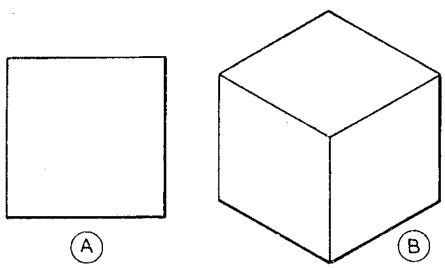


Fig 14 *Orthographic and isometric projection of a cube*

part of it, and two methods of representation are shown in Fig. 12. For the sake of simplicity, a bolt, washer and nut have been chosen as an example to show the principle employed, and quite clearly there is no necessity to use the more complicated method shown in Fig. 12B to illustrate such a simple subject, since the drawing in Fig. 12A is adequate.

The draughtsman should always remember that, because he can understand his own drawing, he must not assume that all others can do so. It is a good plan, therefore, to try to make simple exploded views and to use this technique whenever it is thought that it will help to make the drawing clear to the reader. Exploded views are used extensively today in instruction manuals, and an example from this source is illustrated in Fig. 13, reproduced by courtesy of Messrs. J. A. Prestwich and Co, Ltd., Tottenham.

Isometric Drawing

The war was responsible for an enormous increase in our manufacturing resources as

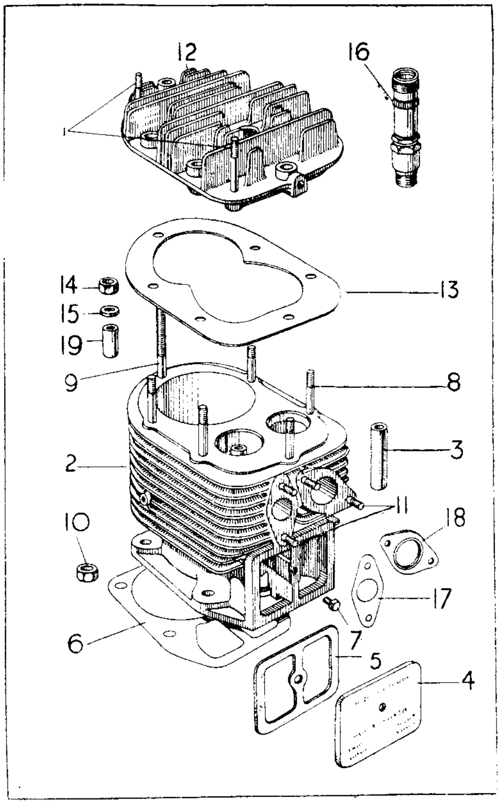


Fig. 13 *An exploded view*

well as a great advance in the complexities of design, consequently it is hardly surprising that there were difficulties in interpreting some of the drawings provided. So, in order to make the drawings intelligible to the workshop staff, a new technique was developed and isometric projection or "three-dimensional drawing" to give it the more modern name, began to be used to illustrate the more complex components. Isometric projection itself is not a new technique, but the Leate system of three-dimensional drawing as used professionally is new and allows

projection to be carried out at any angle, whereas the original isometric projection could only be used at 60 and 30 degrees.

These drawings are built up from the normal or orthographic projection, in which three separate views are necessary to interpret the draughtsman's intentions, and are made by projecting the outline of the component, usually at 30 deg., each side of the centre-line of the orthographic drawing.

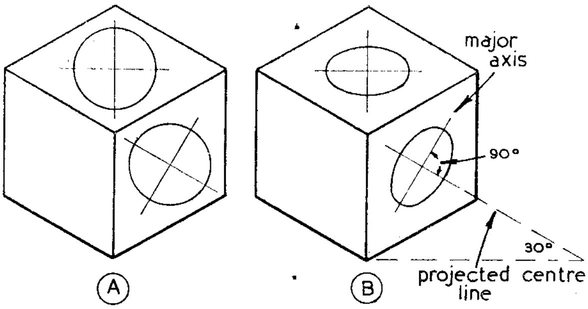


Fig 15 *Showing the use of the ellipse*

For example, if a cube is to be clearly represented orthographically, three views are needed as in Fig. 14A, but if projected isometrically its form will be apparent in one drawing as in Fig. 14B. Clearly in the latter representation some foreshortening of the horizontal and vertical lines must be made to give the correct appearance. It is usual to make these lengths 0.8 of those in the orthographic drawing.

Use of the Ellipse

If it is required to show a hole in a three-dimensional drawing such as Fig. 14B this cannot be done by simply drawing a circle as in he case of an orthographic representation, for, owing to the tilting of the surface, the outline of the hole becomes an ellipse. This can be demonstrated quite simply by taking a coin and tilting it at varying angles. Figs. 15A and 15B show clearly the difference in appearance effected by making the holes elliptical. For the purposes of three-dimensional drawing, meticulous accuracy in drawing an ellipse is not essential and there is fortunately a quick and simple method by which ellipses can be drawn ; moreover, it is one well suited to the 30 deg. projection under description.

To draw an ellipse correctly the centres of its major and minor arcs must be found ; these can readily be determined in the following way. First draw a circle with diameter AB equal to the major axis of the ellipse, Fig. 16A. Then place a 60 deg. set-square, resting on the T-square, with its edge on the point X and draw two lines CD and EF through AB, Fig. 16B. Draw by the same method two lines GH and IJ from the point Y. The points O and P at which these lines cut the line AB are the centres of the minor arcs and the centres of the major arcs are X and Y.

With centres O and P and radii OA and PB describe the two arcs cutting CD, IJ at C^1 and J^1, and FE, GH at F^1 and H^1 Fig. 16C ; from centres X and Y and with radii XC^1 and YH^1 (these are, of course, the same) scribe the two major arcs, Fig. 16D, to complete the ellipse.

With practice it will be found, except perhaps when drawing large ellipses, that many of the steps can be omitted. For example, the circle with diameter AB need not be drawn ; instead, the four points A, B, X and Y are pricked off on the cross centre-lines with dividers. Similarly, constructional methods need only be used to find the centre of one of the minor arcs, the other may be stepped off with dividers from the centre of the imaginary circle $ABXY$.

After the minor arcs have been described, it is a simple matter to estimate the radius of the major arcs by eye, and the compass is adjusted so that the two arcs blend.

It has been noticed that the positioning of the

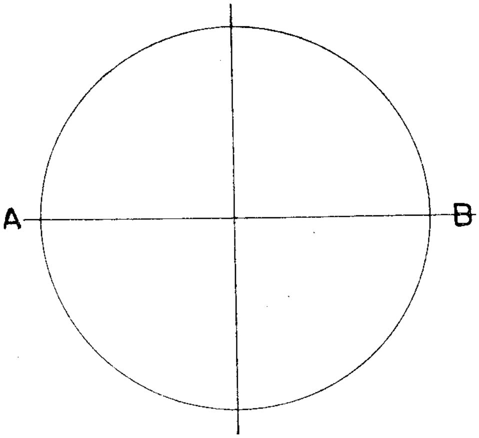


Fig. 16A

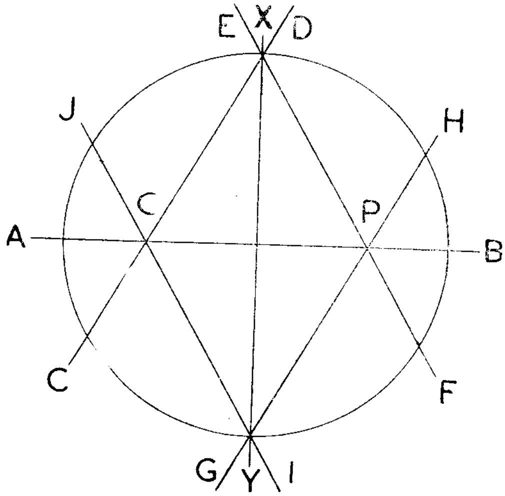


Fig. 16B

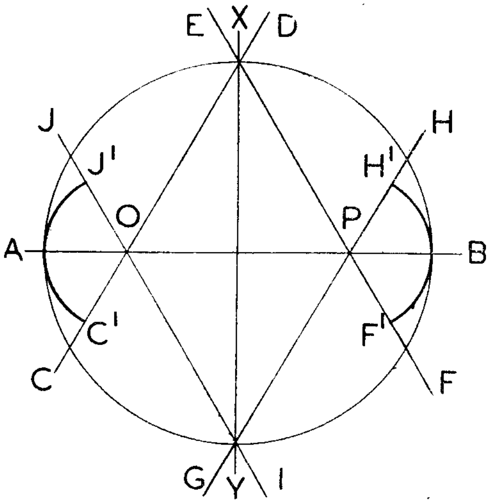


Fig. 16C

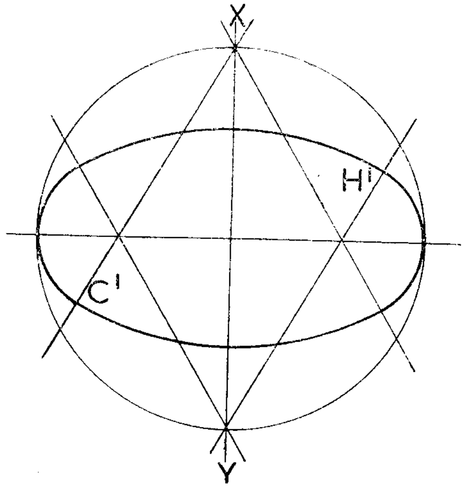


Fig. 16D

ellipse relative to the rest of the drawing sometimes causes difficulty to those unfamiliar with the procedure. If it is remembered that the major axis is *always* at right-angles to the projected centre-line, no trouble should be experienced. Thus, in Fig. 15B, the projected centre-line is shown at 30 deg. to the T-square on the drawing board, whilst the major axis is at right-angles to this centre-line.

By using ellipses and positioning them correctly any engineering component can be built up isometrically from an orthographic projection.

The foreshortening referred to in connection with Fig. 14B is, of course, applied to all parts of a component as it is drawn. Thus, supposing that attached to the cube shown in Fig. 14B there was a stud projecting from a side face and that stud projected for a distance of 2½ in., the length of the stud as drawn would be 0.8 of 2½ in., that is 2 in. This measurement would be the distance apart of the centres for the two ellipses.

The point at which the stud merges into the cube is found by measuring the two distances *a* and *b* and subjecting the dimensions found

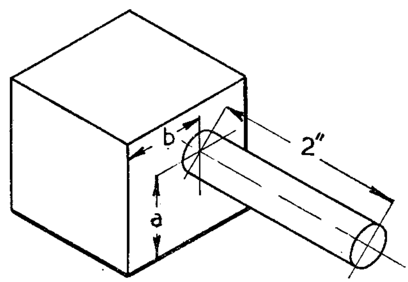


Fig. 17. *The application of foreshortening to the location of components*

to the foreshortening previously mentioned, Fig. 17.

(*To be continued*)

Making an Oilcan

(*Continued from page* 177)

All that remains now, is to make the spout. You will need to shape a piece of wood for this, about 6 in. long and ½ in. diameter, tapering to a sharp point. Roll a piece of paper around this, and, with a very sharp knife, cut along the centre. Trim the ends, and you have your pattern from which to cut the tin, as Fig. 9. Bend the tin around the wooden former as much as possible with fingers, and follow this up by putting on a solid surface, and tap edges of tin until it is wrapped tightly around the former. The largest diameter of spout should be a little less than the recess in brass nozzle, into which it fits.

Tin the recess of nozzle, and end of spout, put one into the other, and fill with solder. Now solder the seam of spout, and for this a soldering iron is best. When cool, slightly bend spout about 1 in. from top, with fingers.

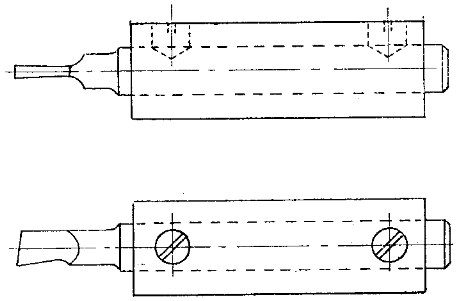
Cut a leather or cork washer to fit over thread of nozzle, and after filling with water to try for leakage screw home. The can only needs a coat of paint, leaving brasswork and spout polished, and you have a good oilcan which will last for years. Don't forget to wash in running water immediately after soldering, and dry quickly in front of a fire to stop it rusting.

—S. G. ACKERMAN.

*UTILITY STEAM ENGINES

by Edgar T. Westbury

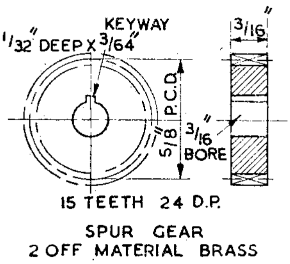
SOME constructors have suggested that they would prefer to make the cams separately, and pin them to the shaft afterwards ; there is no objection to this, provided that they are both formed and located accurately, and secured firmly in place. But it is actually much easier to make the camshaft in the way described, which not only ensures that the correct form and accurate timing is obtained, but is also immune from any risk of the cams shifting. The possibility of being able to vary the timing of one or both the cams for experimental purposes might be an advantage in some cases, but it would be very difficult to carry this out in a practical manner in so small a shaft, and one might do better to make separate camshafts to try out experiments of this nature. It is possible to adapt the cam-turning jig to index the cam blanks in any position, and for any number of cams required.



Slotting tool for internal keyways

The fact that this method of cam forming ensures accuracy only of the cam flanks may lead some readers to think that its value is limited, and that some method of producing the complete cam form automatically would be an improvement. This is quite true—but I know of no really simple method of carrying out this idea. It is possible to generate accurate cams by milling, using a combination of indexing and radial feed, but this not only calls for most meticulous setting, but also for a carefully worked-out valve-lift diagram. Copying methods of cam forming are excellent, but for single operations, the production of master cams is just as difficult as carrying out the actual job right away. It is commonly believed that errors can be minimised by making enlarged master cams, but this is only true if copying can be carried out by a two-dimensional reduction process, such as by a pantograph system of cutter control.

In practically all types of cams, the flank contours do most of the work, and their accuracy is more important than that of the cam nose ; moreover, the position of the flanks determines the timing and length of opening period. It is logical, therefore, to concentrate on producing accurate cam flanks, even if other parts of the contour have to look after themselves to some extent. The success of the methods described is demonstrated by their application to model petrol engines, where the duty is very exacting, on account of heavy valve loads, high lift, and high speed.



Timing gears

Timing Gears

For normal duty, brass gears have proved quite satisfactory, though steel would be better, especially if one of the gears is case-hardened. It is not a very difficult job to cut gears of this size, either by milling or planing methods, in a simple lathe, and sufficient information has been given in THE MODEL ENGINEER at various times to render it quite unnecessary to deal with these processes here. Ready-made gears of the required diameter are, however, available from THE MODEL ENGINEER advertisers, and may also be obtained from "surplus" apparatus. The pitch and number of teeth specified need not be strictly adhered to, so long as both gears have the same pitch and number of teeth, and the pitch diameter is approximately correct, to conform to the required centre distance between the driving and driven shafts.

Coarse-pitch gears are preferable for several reasons ; they give the maximum shear strength of teeth, maximum latitude in meshing accuracy, and generally run quieter than fine gears because the frequency of tooth engagement is lower, and toleration of errors is in proportion to the size of the teeth. It is not, however, desirable to use less than 12 teeth in a gear of this type, and the 15 teeth suggested is intended to represent the best all-round compromise. With this number of teeth it will be necessary to set the gears on their shafts in such a way as to time the tooth positions correctly in relation to valve timing ; the angular spacing of the teeth is 24 deg., and it is clear, therefore, that quite an

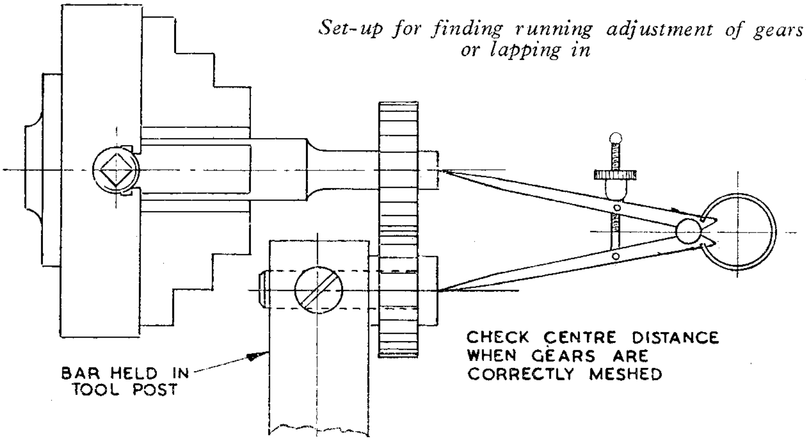
*Continued from page 110, "M.E.," January 26, 1950.

appreciable error in valve setting may be produced if the teeth of the gears are not correctly located. It is therefore desirable, when setting the valves, to key one of the gears to its shaft, the other being left unkeyed for the time but made a press fit on the shaft, so that it can be turned stiffly into the required position, and the keyway in either the shaft or the gear located accordingly.

held in the chuck. A similar method could be applied to forming shaft keyways, in the absence of any form of milling equipment, though the latter is preferable in this case.

Locating Shaft Centres

It will be noted that nothing has yet been said about drilling the holes in the two crankcase endplates to take the camshaft bushes. If one



Set-up for finding running adjustment of gears or lapping in

Cutting Internal Keyways

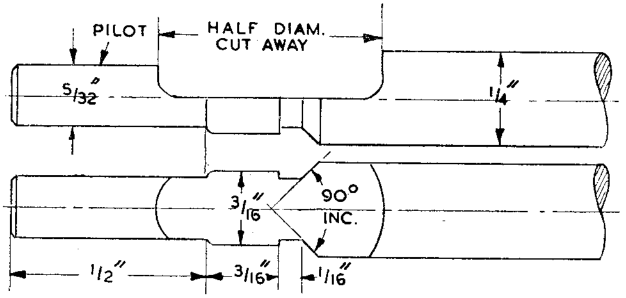
To cut the internal keyway in the gear, a simple slotting tool in the lathe tool post is advised. Owing to the small diameter of the hole, the common method of using a parting tool on its side is hardly practicable; in any case, a tool of this kind is not ideal, and one never has just the right width of tool immediately available, anyway. I generally make slotting tools from round silver-steel, which must not be larger in diameter than the bore of the wheel, though for a very small hole, as in this case, it is best to turn down the end of a larger bar. This is filed flat for a sufficient length to deal with the required depth of the hole, keeping the flattened part symmetrical (a "pip" left on the end face will help to ensure this), and to the required width. Slight backing-off both ways to provide "side" clearance is desirable, and one edge of the flat is then filed square, and backed-off to provide the equivalent of "front" clearance; the end face is then filed at an angle to provide "top" rake. The tool is then hardened and tempered at the extreme tip. It is mounted in a block made from a short piece of material, say, about $\frac{1}{2}$ in. square, which is held in the tool post and drilled from the lathe chuck, to a suitable size to take the shank diameter of the cutter. One or more set-screws are fitted to hold the latter in position, and it is advisable to locate the points of the screws in "dimples" drilled in the shank to fix it positively. In this way the correct height of the cutter, and also its angular position, are assured. By traversing the lathe saddle backwards and forwards, and feeding outwards about 0.001 in. at a time, clean, accurate slots can be produced quickly in the bore of wheels

is quite certain that the gears used are exactly $\frac{5}{8}$-in. pitch diameter, it is sufficient to set the position of these out with the aid of the scribing block, with the crank-case assembly standing on its base flange on the surface plate. First locate the main shaft centre exactly, from finely centred plugs in both main bearing housings; then measure off exactly $\frac{5}{8}$ in. vertically above this (a height gauge, or a rule held in a simple stand or clamping block, is useful for this purpose), set the scriber point at the required height, and scribe horizontal lines across each endplate. The use of a watchmaker's lens for obtaining correct measurements is advised, unless one's eyesight is abnormally acute. The horizontal line is intersected by a vertical centre-line on each endplate to locate the position for the centre of the hole, and the latter is then carefully drilled, preferably by setting up the assembly on the angle plate; a reamer is run through from front to back, prior to fitting the bearing bushes.

There may, however, be some doubt about the actual distance between the gear centres, especially if gears from odd bits of apparatus are used, and in such cases, reliance on dead measurement is not good enough. The exact working distance of gear centres can, however, be assessed fairly simply. One of the gears is mounted on a pin mandrel, to run truly in the lathe, and the end face of the mandrel is marked with a fine centre. The other gear is mounted to run freely, but without play, on a pin or shaft which can be held in a suitable holder in the tool post and set parallel to the lathe axis; this pin also has a fine centre on one or both ends. The holder may consist of a piece of square bar, drilled

crosswise to take the pin, and fitted with a set-screw. This set-up, by the way, is also suitable for lapping or running-in the gears in mesh, to ease off minor inaccuracies and ensure sweet running ; a process which is always worth while, whether the gears are bought or home-made.

With the one gear on the mandrel, and the other running on the pin (don't forget lubrication) the cross slide is adjusted to obtain correct meshing, so that the gears run smoothly and silently with the minimum backlash. If lapping is found desirable, keep the loose gear moving endwise all the time, and disengage it frequently, engaging again in a different tooth position, to even out the abrasive action all round each gear. Running-in should be done at high speed, with oil only, and continued until the oil comes out clean, showing that no traces of the abrasive material are left behind.



Valve-seating cutter

The exact meshing distance can now be measured by fine-pointed dividers from the centres at the ends of the gear shafts, again using the lens to ensure accuracy, and the measurement is then transferred to the scribing block or height gauge to find the vertical position of the camshaft centres. There should then be no possibility of error in the meshing of the gears when the engine is assembled. If, for any reason, however, the gears are found to be incorrectly meshed, it is possible to correct this by fitting eccentric bushes, but this is not very desirable, because it is not at all easy to adjust the position of the bushes in both end-plates to obtain perfect alignment of the bearings.

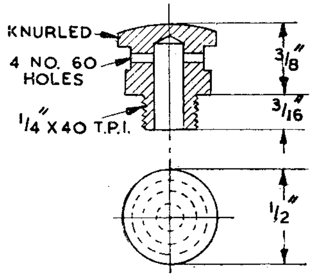
Engine Assembly

There should be very little in the way of fitting required when the engine comes to be finally assembled. After the crankcase is assembled, with the main shaft, follower and camshaft in position, the cam timing should be set, with the crank on one of its horizontal dead centres and the inlet cam on that side just commencing to lift, for the required direction of rotation. This will be found just about equivalent to 40 deg. angle of advance, in terms of normal slide-valve action, and will be found suitable for general purposes ; slight variations of timing on individual valves can be obtained by adjusting tappet clearances, though these should normally be as fine as possible.

The joints at the cylinder bases and heads, also the valve cover, may be made metal-to-metal, or with a thin paper washer. Minimum clearance should be allowed in the cylinder heads when the pistons are at top dead centre.

Valve Seatings

It has been mentioned that a special tool is advisable for producing the valve seatings. This consists of a specially-made D-bit, having a piloted end, beyond which is a parallel cutter which reams out the upper part of the valve guide, and a mitred cutter which produces the seating. The tool may be used in the lathe, drilling machine or hand brace, running at slow speed, and after running the parallel cutter in almost to full depth, the swarf should be carefully cleared before the mitre seating is machined. On no account use more end pressure than is necessary to take a mere scraping cut off this seating, and the cutter must not be allowed to snatch or chatter. The seating should not be more than about 1/64 in. wide, and if carefully faced will require little or no grinding-in.



Crankcase breather

When the heads are assembled, and the valves adjusted with the aid of a screwdriver and spanners, their timing may be checked by turning the engine to the inlet and exhaust opening and closing positions on both cylinders. It will be found that timing is not materially different from that of a normal slide-valve engine, except that the cut-off of steam is earlier, and that all valves open and close quicker than with a slide valve.

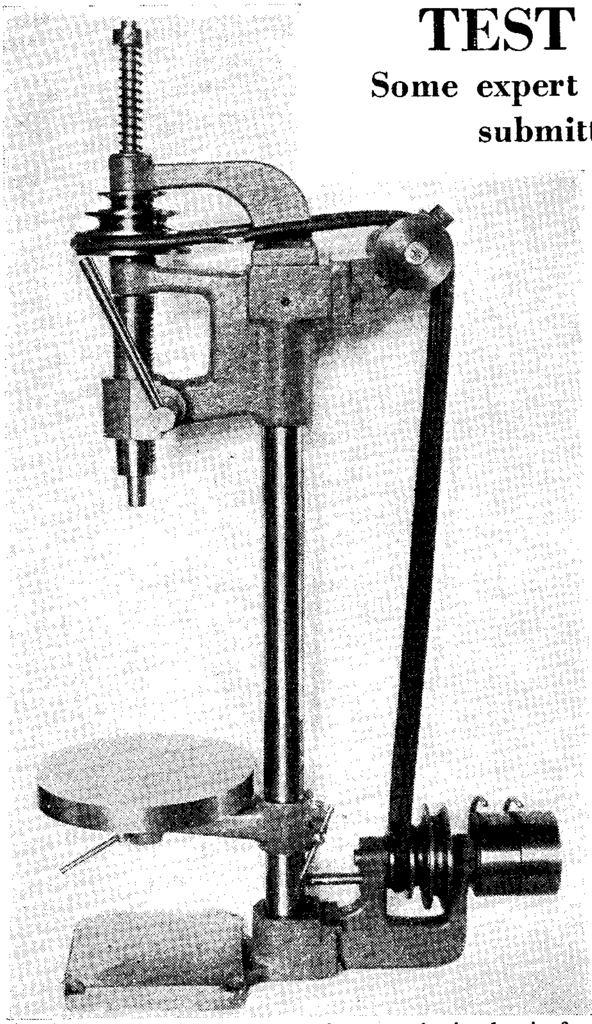
Crankcase Breather

It is necessary to ventilate the crankcase of any enclosed engine, and the breather is also used as the oil filler, in cases where splash lubrication is relied upon. As already mentioned, I strongly recommend feeding oil through the crankshaft, in order to ensure that it reaches the places where it is most needed, but the fact remains that many small steam engines apparently work quite successfully with nothing more elaborate in the way of lubrication than a drop of oil poured into the crankcase now and again ; and if users of these engines are satisfied, well, so am I. In any case, it does not affect the design of the breather, which is just a vented screw cap, the apertures of which should preferably be located so as to deter any tendency to oil spraying

(To be concluded)

TEST REPORTS

Some expert comments upon items submitted by the trade



The Perfecto Drilling Machine

THIS machine of $\frac{3}{8}$-in. capacity was submitted for testing by the manufacturers, the Perfecto Engineering Co. of Leicester.

As will be seen in the photographs, the design of the machine follows standard practice except, perhaps, with regard to two notable features.

The fitting of the return spring to embrace the upper end of the spindle undoubtedly has certain advantages, but the more usual method of attaching this spring to the pinion shaft has, nevertheless, proved satisfactory in practice; for the spring tension then remains nearly constant through the feed range, and, moreover, a simple form of depthing-stop can also be fitted to the spindle itself.

When fitting the spindle with a third or outboard bearing, advantage has been taken of making the headstock casting in two units, which are secured together by four $\frac{3}{16}$-in. Whitworth screws provided with an ample clearance of 20 thousandths of an inch to ensure that they do not bind in their holes. We would suggest, however, that the two units in question would be better, if located by means of registers, to ensure that the bearings remain in line even when the parts are reassembled after being dismantled; moreover, spot-facing the seatings for the screw-heads would overcome the danger of the fixing screws being bent when tightened in place against an uneven surface.

The main headstock casting has a good bearing $4\frac{1}{4}$ in. in length on the column, to which it is secured by means of two Allen screws. The spindle is a good fit in its two upper bronze-bushed bearings in the headstock assembly; but where it bears in the bronze bush in the quill, the surface shows rather conspicuous turning marks.

No chuck was fitted to the machine submitted, and this probably explains why the spindle nose appears to have been rough-turned for finishing later to fit a drill chuck of the selected make.

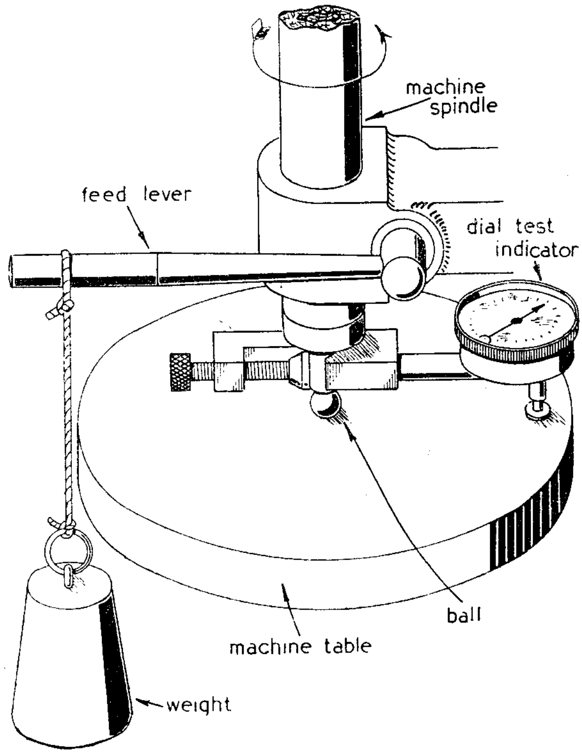
Both the drilling and the reverse thrust are taken on plain bronze thrust washers, and a screwed collar is fitted to the spindle for taking up end-play.

The bronze-bushed quill is a close sliding fit in the headstock casting, and is furnished with the usual form of feed gear comprising a toothed pinion engaging a series of rack teeth cut in the quill.

The jockey pulley shaft has an ingenious form of screw fitting for adjusting the belt tension; but we might, perhaps, suggest that machining flat clamping surfaces on the shaft bracket would ensure that this shaft was positioned horizontally. Also, the fitting of a lever clamp-nut, instead of a hexagon nut, would facilitate setting the belt tension.

The countershaft assembly is bolted to the rear face of the foot table and is furnished with a belt fork and striking gear of straightforward design to shift the 1-in. flat belt on the fast and loose pulleys. Thence, the drive is by means of a $\frac{3}{8}$-in. diameter round leather belt running on cone pulleys, machined with grooves of 30 deg. included angle to afford an adequate grip for the belt.

The $6\frac{1}{4}$-in. diameter plain circular work table



Showing method of applying turn-round test to ascertain accuracy of alignment.

is provided with a spigot by which it is clamped in the table bracket arm ; this bracket is split so that it can be secured to the column by means of a cross-handled clamping-screw. The usefulness of the table would be enhanced were it made with slots for securing the machine vice and other fixtures.

Plain horizontal oil channels are provided for lubricating the spindle bearings ; and, although it is a small point, if these were drilled at an inclined angle they would form an oil reservoir, and at the same time the oil-can could be applied more easily. Lubricators give a finished appearance to a machine and, when fitted with wicks, they help to ensure a continuous supply of oil to the bearing.

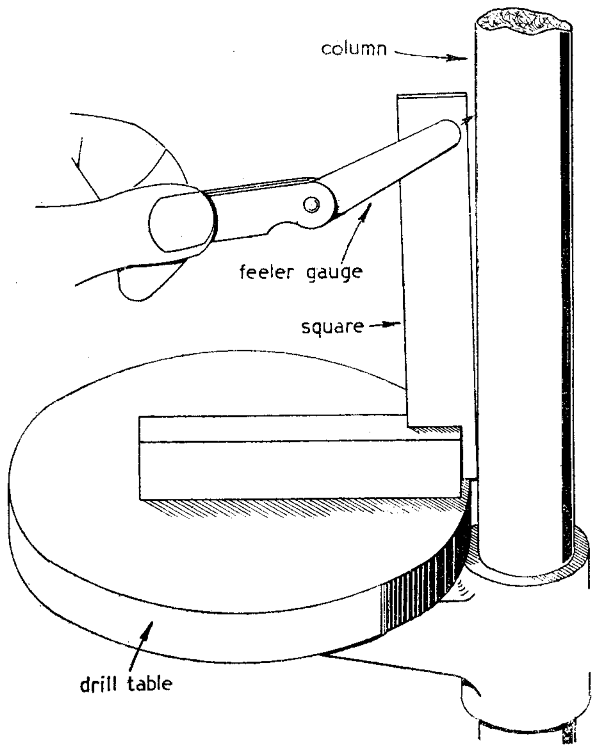
Testing the Machine

As the machine was not fitted with a chuck, there was no possibility of testing it under working conditions of drilling, countersinking and counterboring ; but an estimate of its accuracy was made by applying the usual instrumental tests. As represented in Fig. 1, when applying the so-called turn-round test to check the vertical alignment of the spindle in relation to the table surface, the spindle was end-located against a cycle-ball held in place between the end of the spindle nose and the table surface by means of a light weight attached to the feed lever. The test indicator was then clamped to the spindle nose with its contact point applied to the surface of the table near its outer diameter.

While the spindle was slowly rotated by hand, the maximum deviation record by the indicator was noted. This was found to be 6 thousandths of an inch on a diameter of 6 in. This reading is sufficiently accurate for ordinary work, although we recently tested an amateur-built drilling machine, having a ground steel column, that gave no recordable variation of reading under these conditions.

The table was next rotated on its spigot through an angle of 180 deg. and the test repeated. This gave a 5-thousandths deviation in the same direction, showing that the spigot was truly in line with the table axis.

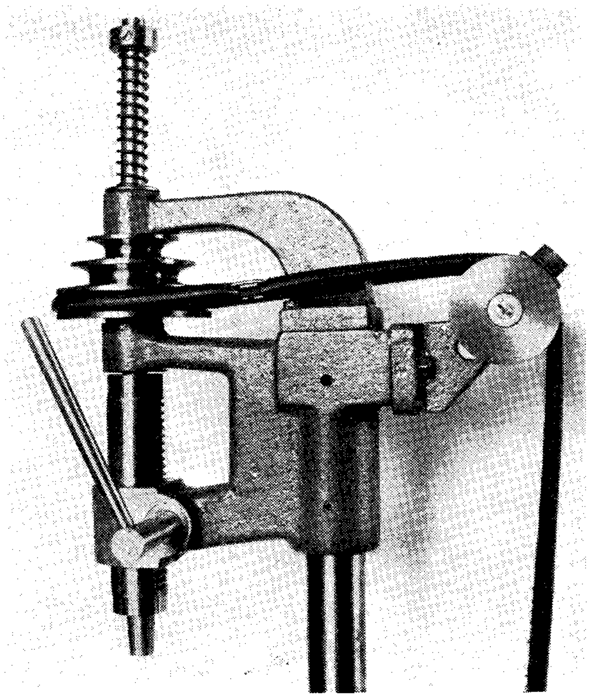
The flatness of the table surface was tested with a standard straightedge and also on a surface plate ; this indicated that the table surface was slightly concave to an extent that could be easily rectified by hand-scraping.



Testing the alignment of the table with the column.

Although a truly flat table is to be preferred, the presence of a slight concavity ensures that a machine vice with a flat sole will not rock when in use.

The angularity of the table in relation to the column was next with a standard try-square, as illustrated in Fig. 2; this showed that the edge of the table farthest from the column was depressed to the extent of 12 thousandths of an inch in a length of 7 in. In theory, any such error of alignment should preferably be in the reverse direction, so that under the pressure of drilling, and as a result of wear, the error tends to become eliminated.



View of headstock assembly.

As a routine measure, the true-running of the spindle nose was tested with the dial indicator clamped to the work table. Turning the spindle by hand then showed a variation of 1½ thousandths ; but, as already mentioned, the nose had not been finished-turned and this test was, therefore, of little value except to indicate that a finishing operation was required when fitting the chuck.

Drilling Speeds

If, in accordance with modern practice, the machine is driven directly from an electric motor, and a 2-in. diameter pulley is fitted to the motor shaft, the three speeds obtainable will be: 600, 1,200 and 2,000 r.p.m. approximately. The highest speed will be suitable for the smallest size of drill likely to be used in a machine of this type, and the lowest speed, according to drill manufacturers' recommendations, will enable carbon steel drills up to ¼ in. diameter to be used for drilling steel. Larger drills, up to the full capacity of the machine, will have to be of the high-speed steel variety if they are to stand up to drilling steel at this rate of revolutions.

It is to be feared that even the lowest speed obtainable is too high for successful countersinking and counterboring operations, in all but the smallest holes, and some provision would have to be made to effect a reduction of speed ; the manufacturers, no doubt, have this in mind and would be able to supply the necessary information.

To Traction Engine Enthusiasts

WE frequently receive enquiries from readers who want to know where they can obtain *detail* drawings of various makes of road locomotives and traction engines. There are not many such drawings available yet on the market ; in fact, we know of only two sets, both for a Burrell engine. One set is for the 2-in. scale showman's engine, *Thetford Town*, designed by Ronald H. Clark and available from Dick Simmonds & Co., of Erith, and the other is for the 1½-in. scale single-crank compound traction engine for which six sheets of drawings, together with castings and parts, can be had from A. J. Every, of Ealing. Both firms advertise these products in THE MODEL ENGINEER.

For Marshalls, Fowlers, Wallis & Steevens and others, we do not know of any detail drawings other than those which may have been published in back volumes of our contemporaries. *The Engineer* and *Engineering* which can often be found in public libraries.

Our own growing series of traction engine drawings, particulars of which can be found in our Catalogue of Plans and Working Drawings for Modellers, are all general-arrangement drawings ; but they include a fair amount of detail in elevation and plan which would enable many enthusiasts to settle the details for themselves. This is not a very difficult matter to anyone who has studied the variations of detail as between one make of engine and another ; after all, like railway locomotives, traction engines are basically similar to each other, though their variety was very wide, especially if we take into consideration the large number of different makes which were common in America

PRACTICAL LETTERS

The Double Slide-valve

DEAR SIR,—I was pleased to see Mr. J. A. Bamford's letter questioning Mr. J. I. Austen-Walton's statement that "the pressure on a slide-valve is proportional to the area of the ports it covers, and not to the total or gross area of the valve face." I also read Mr. Austen-Walton's letter at the time of publication, and thought seriously of offering a correction to his somewhat sweeping statement. Since, however, Mr. Bamford has broken the ice, I feel sufficiently intrigued to disagree with the statements of both gentlemen, and I fear, especially Mr. Bamford's statement that the pressure on the valve is proportioned to the projected area of the exhaust cavity.

A very important point that neither gentleman mentioned was the fact that the pressure or weight upon the valve face varies in relation to the position of the valve, and is also modified by the opposing or equalising pressures in the cylinders and exhaust pipe. In order to eliminate the rather complex effects of these latter pressures, we must imagine the engine to be static, or stalled, and to assume the valve to be in the maximum or minimum positions of pressure loading.

These positions are :—

(1) Mid-position. All ports covered (maximum loading).

(2) End position. One steam port open, the other exhausting.

For simplicity, let us assume the areas of each steam port to be 1 sq. in., and the cavity of the valve to be 4 sq. in. The steam pressure, we will say, is 100 lb. per sq. in.

Then, in (1), mid position, the weight of the valve will be $(1 + 4 + 1) \times 100$ lb. per sq. in $=$ 600 lb., and in (2), end position $(0 + 4 + 1) \times 100$ lb. per sq. in. $= 500$ lb.

Had Mr. Austen-Walton's formula been applied to the same conditions and values, the answers would have been : (1) $(1 + 2 + 1) \times 100$ lb. per sq. in $= 400$ lb. ; (2) $(0 + 2 + 1) \times 100$ lb. per sq. in. $= 300$ lb.

I am a little uncertain as to what Mr. Bamford means to convey in his wording "projected" cavity, but I construe his meaning to be the effective cavity area of the valve.

Applying the same figures as above, Mr. Bamford's reasoning would give the following pressures :

(1), $(0 + 4 + 0) \times 100$ lb. per sq. in. $= 400$ lb. ;
(2), $(0 + 4 + 0) \times 100$ lb. per sq. in. $= 400$ lb.

Although I disagree with this reasoning, I do uphold Mr. Bamford's remarks upon the portless valve face.

The foregoing remarks are, of course, based on the assumption that we are dealing with a simple unbalanced slide-valve. The figures chosen represent an exhaust port of twice the steam port area and a valve cavity of twice the exhaust port area, which is fairly representative of many steam engines.

Needless to say, it is the maximum loading position of the valve that must be considered when calculating stresses imposed on the valve-linkages. Super-large-port enthusiasts are apt to overlook this.

Yours faithfully,

Maidstone. E. G. RIX.

"General Buller"

DEAR SIR,—I read Mr. D. L. Allen's account of the *new* machine, done up as an *old* one complete with centre engine, belonging to Messrs. Bottom Bros. For the benefit of all, may I state that the very fine centre engine *was* the driving gear of the roundabout prior to electrifying same, and is still in good order, in case they had an electric breakdown. Reason the motion-rods are off, is to save needless friction in the cylinders, because the motor drives by chain to said *real* crankshaft.

Re. chimney. This was put on the large 4-abreast machines and *is* a dummy ; to my mind, it spoils the look of the engine. Messrs. Walkers made this chimney a feature, I believe, on their usual sets. Some have been put on for "flash" when the showmen discarded the organ model, when the motor drove the organ, after modification.

No Sir ! This engine is a very fine actual machine and is kept spotless. Mr. Allen may like to know that the machine is at least 36 to 40 years old at a rough estimate, and it speaks well of Savage-built roundabout gear. The organ is about as old, and a fine instrument it is.

Messrs. Bottom have done it all up in a very lavish style. For many years this roundabout travelled the West Country, owned by Charles Heal, of Bristol. At Southend this ye r is another West of England set of same size, with centre engine all complete, but run as Messrs. Bottom's.

Yours faithfully,

Erith. ALAN BLOW

DEAR SIR,—I read with interest the "Smoke Ring" in THE MODEL ENGINEER, for October 27th, in which Mr. D. L. Allen of Gravesend describes a showman's roundabout which he has seen.

First, I would like to correct a statement in the description, which says that a highly polished brass chimney was never to be found on a real centre engine. As a matter of fact, there was a Savage-built 4-abreast machine in the West Country up to about 12 months ago, which possessed this feature. It was owned by Mr. Charles Heal, of Bristol. But here comes the main point of my letter.

Besides having the polished brass chimney on the smokebox (it was a dummy of course), the centre engine, also bore the name "General Buller," and, very strangely, the machine was sold by Mr. Heal to Messrs. Bottom Bros., the firm mentioned in the article.

Can it be that Mr. Allen is mistaken and that the roundabout which he has seen is this one redecorated, or has the original centre engine "General Buller" been installed (in an incomplete state) in a new machine, or is it just coincidence ?

Yours faithfully,

Ruardean. ALEC K. POPE

Showman's Centre Engines

DEAR SIR,—I have been very interested in Mr. Ronald H. Clark's fascinating series of articles on Traction Engines, particularly that section dealing with fairground centre engines. By a coincidence, the same week that Mr. Clark mentioned the old overtype duplex centre engines, one of these relics appeared driving a galloping horse merry-go-round in the market square at Ashton-under-Lyne, Lancs. The revolving circular pelmet bore the legend "Collin's Grand Electric Steeplechasers," the word "electric" being no doubt justified by the fact that the outfit was brilliantly lit by half-watt bulbs! I believe the present owner had acquired the roundabout at a very reasonable price, and it was doing a good trade with the children of the neighbourhood at sixpence a time. The two-cylinder centre engine was working well, being complete with governor (idle) and an automatic cylinder and crosshead oiling device. The organ engine occupied the position usual for a chimney on a normal overtype engine, and was working an organ which was missing on many notes. The lagged boiler was painted maroon. Mr. Clark (October 13th issue) mentions a large Collins compound traction engine named "The Wonder," and by a further coincidence, the little engine I saw at Ashton was called "The Little Wonder."

In your issue of October 27th, you mention in "Smoke Rings" a dummy centre engine on a modern merry-go-round complete with highly polished chimney which you state is something never seen on a real engine. This is by no means correct, since over 50 years ago, Gheoghan's Galloping Horse merry-go-round which used to tour Lancashire, including Urmston, was complete with a dummy chimney in polished brass and copper, and the whole centre engine was a gleaming mass of polished parts. The organ engine of this equipment was placed at some distance from the main engine occupying a pedestal close to the organ.

Yours faithfully,

Manchester. RICHARD B. WILLCOCK.

Steam Cylinder Passages

DEAR SIR,—To all interested in this subject I would recommend a study of a paper entitled "The Development of Locomotive Power at Speed," which was presented to the Institution of Mechanical Engineers by E. L. Diamond. The paper, with the discussion that followed its presentation, and contributions from overseas members is printed in their Proceedings for 1947, Vol. 156, No. 4. No doubt copies are available in many public libraries.

There seems every reason to suppose that what professional engineers have found best for full size locomotives should apply equally to models in most cases.

In that paper reference is made (page 412) to an old rule that the cross section of the steam passages should be one-tenth of the area of the pistons and to a case where increasing the ratio to one-fifth was found beneficial.

Some people believe that this rule should apply to all steam passages and pipes between the boiler and the pistons.

Another old rule, first presented to the Institution in 1852 was that the volume of the high pressure steam chests should be equal to that of one cylinder. This was forgotten until about 25 years ago, since when its adoption has been widespread and has undoubtedly contributed very considerably to the improvement in performance of engines at high speed.

With reference to Mr. H. Bristow's letter in THE MODEL ENGINEER of December 29th, surely there has been a slip somewhere. Taking his formula and the facts supplied by Mr. K. N. Harris :—P = 65. L = 1/12 foot. A = 0.196 sq. in. N = 1900, so that the i.h.p. of each cylinder would be 0.6 h.p. and for two cylinders 0.12 h.p.

With reference to N. Scrouther's letter in your issue for January 5th, it is not clear what he means by roughness in running. Had he stuck to his large steam passages and used a better design of valve gear and setting, there is no doubt that he would have had a successful engine. It must be acknowledged that one fault can be hidden or suppressed by adding another.

In conclusion, may I draw the attention of Mr. K. N. Harris to some remarks by Dr. W. A. Tuplin, M.I.Mech.E. reproduced on page 425 of the I.Mech.E. Journal referred to above?

Yours faithfully,

Hatfield Heath. A.W.P.

International Racing

DEAR SIR,—I feel that I cannot let the correspondence on "International Racing" pass without saying "my piece" on the subject. The discussion has resolved itself into a "home-built" *v.* "shop-bought" controversy. Surely the answer is "live and let live." It takes all sorts to make a world. Some of us run boats out of the old seafaring instinct, some out of a love for competition, some to test their engineering abilities, (and I suggest there is no sterner test than speedboat racing). Provided that we are getting what we desire out of the game, I see no occasion for mud slinging. I would say, however, to the man who buys an engine, "don't attempt to appear superior, because you're not," and be man enough to admit that you run a commercial engine, because its faster than anything you can make. Don't recite the fairy-story that you haven't time to build an engine.

Now for Mr. Haswell. I whole-heartedly support his plea for covering all model subjects in THE MODEL ENGINEER, and this to the exclusion of non-models.

Yours faithfully,

Hendon. A. F. WEAVER.

The Vertical-boiler Roller

DEAR SIR,—The photograph submitted by "A Model Engineer on Tour," appears to be a Marshall Millais Tandem Steam Roller. The Liverpool Corporation had one or more some years ago. Regarding the roller, the boiler is offset from centre on nearside position, fire-door on opposite side, coke fired. The steering can be automatic or hand-operated, a small three-cylindered engine operating the steering tiller through a worm, as far as I remember. The rear roller is chain-driven from the engine and was water ballasted. I should conclude they were ideal steam rollers for the job.

Yours sincerely,

Roby. A. EDWARDS.